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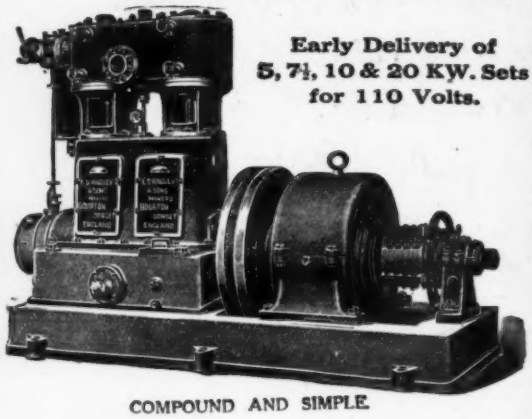

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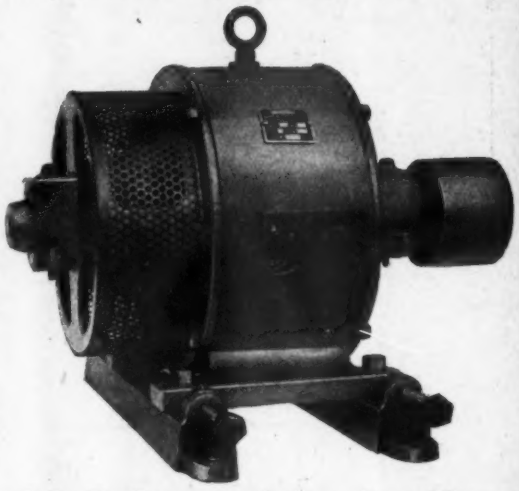

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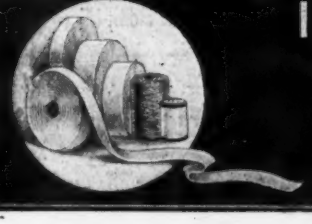

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ELECTRICAL REVIEW.

VOL. XC. JANUARY 6, 1922. No. 2,302.

ELECTRICAL REVIEW.

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1921.

To write of the past year is a task which offers little attraction and excites no enthusiasm whatever. That it was, in many respects, the most wretched year that the electrical industry has experienced since its inception is a moderate expression of our feelings, and we are sure that no one will regret its passing.

Nevertheless, the year was not wholly devoid of interesting features in connection with electrical progress. The Electricity Commissioners in the course of the previous year had provisionally determined thirteen "Electricity Districts," all of which were shown on a map that we published on January 7th, 1921, and that number remained unchanged until December when the fourteenth area was provisionally delimited; in the meantime the Commissioners commenced the holding of the statutory inquiries, of which five have been completed, namely, Mersey, North Wales, West Riding, London, and South-West Midlands.

Decisions have been announced in respect of all of these, except the last-named. The Lower Severn inquiry, the first to be opened, was adjourned and eventually abandoned; several others have been postponed. The proceedings at these inquiries assumed unexpected proportions and revealed a regrettable lack of cohesion between the various authorities, but on the whole valuable results were attained in the abstract; for the concrete outcome of the work that has been done we must await the passing of the supplementary Electricity (Supply) Bill, which was introduced but failed to mature in Parliament, and the holding of the additional inquiries which are required under the 1919 Act. Much has been done, but an enormous amount remains to be accomplished, and the Commissioners will have their hands full this year.

Much attention was devoted to the better utilisation of the natural resources of this country, especially during the prolonged strike in the coal-mining industry, and the scheme for harnessing the tidal flow of the Severn was seriously discussed. The final report of the Water-power Resources Committee, recommending that a Central Water Commission be formed and that a Government department should exercise control over water power, also suggested special investigation of the Severn scheme. Two important schemes were under consideration in Scotland, and the North Wales Power Co. was authorised to extend its activities.

The subject of railway electrification was advanced a stage by the publication of the reports of the Advisory Committee appointed by the Minister of Transport, which, if they did not cut the knot of controversy, at any rate set the seal of official approval on the high-pressure direct-current system, and the decision of the North-Eastern Railway Co. to proceed with the conver-

sion of 250 miles of track to electric traction was a notable event, this being the first big main-line electrification in this country. The importance of this departure should not be under-rated; other big schemes are under consideration, and when they are put in hand large orders for electrical plant and equipment will come into the market. Similar noteworthy schemes were initiated in South Africa, Australia, and New Zealand, and the inauguration of new rolling stock on the London underground railways during the year helped to provide employment for British workmen.

In the manufacture of high-pressure underground cables this country takes second place to none; nowhere else, we believe, are such cables in use for alternating pressures above 20,000 volts, but here three-phase cables were laid last year to work at 33,000 volts, and tested in position with a pressure of 90,000 volts d.c.

In the electricity supply industry the subjects of predominant interest were cheap wiring and multi-part tariffs; whilst no striking development took place in either case, the consideration given to them is bound to bear fruit. In the meantime the number of metal-sheathed wiring systems on the market has materially increased. Noteworthy reductions were effected in the prices of electrical energy and electric plant.

The Institution of Electrical Engineers at last was able to resume possession of its own building on the Embankment, a change which was highly appreciated by the members; an innovation which failed to arouse enthusiasm was the enhanced rates of subscription, but notwithstanding this, the membership continued to increase, approaching 10,000, and considerably exceeding that of any similar society. The fact that on the 17th of May, 1921, the Institution completed an existence of half-a-century was not the least notable event of the year, which was also marked by the grant of a Royal Charter.

Progress in lighting was marked by the introduction of the 40-watt gasfilled lamp, whilst the validity of the patent for this type of lamp was affirmed over the heads of two lower Courts by the House of Lords.

In spite of the adverse circumstances, in social aspects the industry made a further advance towards the pre-war standards; the Electrical Engineers' Ball was held again after a lapse of seven years, and the establishment of the Engineers' Club, which scored an immediate success, filled a want of many years' standing.

With regard to the commercial features of the year, perhaps the less said the better; a review of some of the financial results appears in our "Stocks and Shares" article to-day. We must, however, refer to the extraordinary proposals to transfer our heavy electrical manufactures to German hands, which met with a prompt and emphatic protest from the industry, and to the withdrawal of the E.P.D., which, however, evoked no such indignation.

We regret that the death-roll of the year was exceptionally long and heavy; amongst those who left us were Lord Moulton, Sir James Pender, Mr. J. H. Balfour Browne, Lord Balfour of Burleigh, Lt.-Colonel P. G. von Donop, Sir Douglas Fox, and many other men eminent in science and industry; whilst the ELECTRICAL REVIEW suffered the loss of its Editorial and Technical Director, Mr. Tom E. Gatehouse, who for some forty years had presided over its editorial department, and of his old friend, Mr. W. H. Booth.

The Coming of Confidence?

SIR W. J. NOBLE, President of the North-East Coast Institution of Engineers and Shipbuilders, writing to *The Times* on the industrial outlook, holds that it is the paralysis of fear which must be healed if our trade is to regain health and strength. What is needed more than anything else is confidence, and experience has shown again and again in times of stagnation that confidence is a flower of very gradual growth. It cannot flourish in an uncongenial atmosphere or in an infertile soil. Confidence begets enterprise, and that is what many people are burning to show just as soon as ever the conditions at home and abroad—whether they be due to rates of exchange or to industrial relations and terms—are stable enough to establish confidence. There is plenty of spirit amongst us making for enterprise—the knowledge of the world opportunities awaiting the engineer is sufficient alone to engender such spirit, and we may hope with Sir W. J. Noble that there are visible from our little watch towers faint streaks of light, "the promise of better times." If it be true that good trade is in certain respects synonymous with good temper we may derive some satisfaction from the gradually improving relations between employers and employed. The writer asks, in referring to the industrial disputes of 1921, that we "let the dead past bury its dead." There has been too much talking and pamphleteering by men on both sides and by men who are neither one thing nor the other. In his letter to *The Times* Sir William quotes a number of signs which make it clear to him that a new era is opening with the renaissance of confidence:—

(1) An increasing willingness on the part of masters and men to cease the angry denunciation, the one of the other, and together face the common problem of helping sick and stricken industries towards convalescence.

(2) A relaxing of Governmental shackles and restrictions. British trade and industry have suffered seriously from the almost whimsical uncertainties of State interference.

(3) A sense that prices have now fallen to that level which will render them less fickle in the New Year; and once public confidence in the reasonableness and stability of prices for our commodities has been revived, the process of buying and selling (which is an expression of that confidence) will be quickened and extended.

(4) A conviction that the high tide of State expenditure has at long last begun to ebb.

(5) The settlement of the age-long feud in Ireland and the definite agreement sealed and signed at Washington have encouraged a spirit of confidence in the ability of the statesmen of the world to address themselves to the problems which retard the sure and steady flow of international trade.

These are advanced as the chief signs of the renaissance of confidence which is the best of omens for trade and industry in 1922. We desire to support the appeal of the writer when he asks every citizen to help to increase the common stock of goodwill and courage "so that what are at present but a few rays of light breaking through the darkness may grow and multiply into the golden day."

All pull together!

The dawn of a new year is supposed to be an appropriate occasion for the formation of new resolutions of the nature of self-discipline, and for taking stock of one's recent past with a view to amendment in the future; it is, however, more agreeable to prescribe for the ailments of others than to physic oneself, and we propose to ask those of our readers who are more immediately concerned with the development of the domestic load whether they are really individually doing all that they can to foster it.

Those readers may be classified under three heads: electricity supply engineers and managers, manufacturers, and contractors—each class, of course, including some, if not all, of the subordinate officials and employés. The first-named class, provided that they are equipped with plant and mains of adequate capacity, can exercise an immense influence on the public mind if they are so disposed, for they are constantly in contact with their customers and can bring before them the advantages of electrical methods at small additional expense, they can offer apparatus on hire, and they can assist their consumers with advice regarding proposed additions to their electrical equipment, from an impartial point of view. Are they doing all they can in these directions? We have heard of some whose attitude is not all that could be desired, who show a disposition to leave the initiative to others and to wait for clients to come forward; we believe, however, that these form but a small minority, and that as a rule the supply manager is as keen as anyone to advance the cause of electrical development.

The manufacturer does not come directly into contact with the public, but is no less concerned with the promotion of electrical sales, and can further this end not only by improving his products and methods of production, but also by advertising his wares, and we note with interest and satisfaction that within recent weeks quite a notable publicity campaign has been in progress, involving a considerable outlay. In this connection the work of the Electrical Development Association must not be ignored; by concentration of effort under the guidance of E.D.A. far-reaching results are being attained. The assistance afforded by E.D.A. to the supply undertakers must also be acknowledged with appreciation.

Lastly, there remains the contractor, who, coming between the manufacturer and the public, is well situated for reinforcing the advertising efforts of the former and influencing the latter. Obviously the manufacturers' expenditure on publicity is of immediate advantage to the contractor, who should do his share by following it up; many do, but we regret to say that many don't. At a time when contracting work is admittedly slack, it is difficult to understand the apathy and indifference which some contractors display. When municipal authorities endeavour to obtain the right to sell electrical apparatus to consumers, the contractor is up in arms at once to defend his privileges, but does he fully justify this attitude when calm is restored? Does he seize every opportunity to encourage the "other uses" of electricity? Does he realise that that policy would produce the most gratifying returns with the minimum of effort? Or does he engage in the scramble for wiring contracts, which are notoriously the least profitable branch of his business, closing his eyes to the possible sales of fittings, apparatus for cooking and heating, and other domestic electrical appliances? Is he backing up the manufacturer with wholehearted zeal and energy? Some contractors, as we have said, are doing their best, but many are mistakenly devoting all their attention to wiring and overlooking the splendid field for sales of apparatus which is open before them to-day. Let them co-operate fully with the supply managers and manufacturers, and let all three make a New-Year resolution—*to pull together*!

Turbine Breakdowns.

THE breakdown of a large turbine is so serious a matter that every example of such a wreck calls for the closest study with a view to learning as much as possible from so costly a lesson. The comparatively recent development of the turbine has brought us into contact with problems relating to high speeds of rotation for which our previous experience affords little guidance; last year, for example, the extraordinary effect of accidental resonance of the core-bolts of large turbo-alternators was unexpectedly demonstrated by the breakdown of two generators in quick succession, the natural frequency of vibration of the bolts having synchronised with the speed of rotation of the rotor. This was an entirely novel type of failure; once identified, it was easily remedied. In the United States breakdowns have repeatedly occurred from a somewhat similar cause in the rotor of the turbine itself, certain of the large disks used in turbines of the impulse type being set in lateral vibration at particular speeds with the result that the rims are distorted and rub against the diaphragms. In this issue we quote from *Power* some particulars of an exceptionally disastrous example of this class of failure, in which apparently the catastrophe was precipitated by the occurrence of a deep tool mark on the surface of the disk. At our earliest introduction to the principles of engineering, the importance of avoiding sharp corners in turned shafts and castings was impressed upon us by our teachers, and the significance of that injunction has been immensely increased in modern times by the high speeds in vogue. It has been shown that even a scratch on the surface of steel may readily initiate a crack, and the nature of the fractures in the case described leaves no room for doubting that the "deep tool mark" was in great measure responsible for the breakdown of the disk. Wise men learn from the unfortunate experience of others, and we think the lessons taught by this mishap are well worthy of attention.

Hydro-Electric Works in Italy.

ALMOST a calamity has befallen Italy as a result of the drought of the past season and the consequential fall in the level of the rivers, lakes, and the storage reservoirs of the hydro-electric works. Under the circumstances, a great scarcity of electrical energy has arisen—so much so that a Royal decree was issued at Rome on December 22nd, suspending supply for industrial purposes between December 25th and January 1st, in the Province of Lombardy and in the Provinces of Piacenza, Parma, Reggio Emilia, Modena, and parts of Novara, Alessandria, Bologna and Genoa. The companies affected by the decree are the Società Generale Elettrica dell'Adamello, Imprese Elettriche Conti, Lombarda per Distribuzione dell' Energia Elettrica, Varesina per Imprese Elettriche, Dinamo & Brasimone. Representatives of the supply works have met in conference several times, and have adopted measures for endeavouring to counteract the effects of the shortage of water and of energy. The steam generating stations are fully loaded, and are able to do very little to assist in meeting the present emergency, which is affecting the operation not only of industrial works, tramways, and electric railways, but also the needs of ordinary consumers in the towns supplied indirectly by transmission from the distant hydro-electric works.

The Consular Service.

IT is not often that the lions of Carmelite House and Printing House Square lie down with the lamb which acts as the Manchester guardian of public opinion. Yet while the former band, at the instigation of their absent but ever-active chief, are roaring for a more effective Consular service, the columns of the great Lancashire organ have been thrown open to a similar advocacy. This recognition, though tardy, that economy must not be allowed to kill efficiency is a happy sign of discrimination in the "Sack-the-lot" campaign which has been carried on recently by the "stunt" Press. The Consular and cognate forces never have been particularly well endowed either financially, technically, or temperamentally in the fight for trade, but if they are to be robbed of such armoury as they now possess and our commercial interests abroad to be bereft of all official help, such neglect may well be cited as yet another reason "Why your income tax is 6s. in the £." For years we have pleaded that our State emissaries of trade should be well equipped, properly housed, and adequately financed. Sir Edwin Stockton, in addressing the Rotary Club at Manchester last week, referred also to the unfilled vacancies in the Trade Commissioner service, to which attention was called in our leading columns in October last. *The Times* has been pointing out the need for a technically competent headquarters to work in parallel with the overseas officers. For reasons which we set forth on the same occasion we fear that the plea for this essential comes too late. There appears to be some hope that the Geddes committee has not yet dealt with the Department of Overseas Trade and the Commercial Secretarial Service, for we have seen no mention of those branches in the forecasts of its report. We trust that there is still time to bring home to the "powers that be" the need to temper economy with efficiency.

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LATIN-AMERICAN ENGINEERING IN 1921.

Progress in Electrical Projects and Wireless Telegraph Installations.

[BY A SPECIAL CORRESPONDENT.]

1. *Electrical Works.*

In Argentina the Ferrocarril Oeste de Buenos Aires received authority from the Ministry of Public Works to extend the electrification of its railway to the town of Moreno.

The first electric freight locomotive to run in Brazil was put on the tracks in July. Built for the Compañhia Paulista de Estrada de Ferro (Sao Paulo Railway Co.), the engine was of American construction. A few months later, several electric passenger locomotives were added, while progress was made towards the completion of the electrification of the lines of the railway. Construction of a hydro-electric station was commenced on the Pirisicaba River, in the State of Minas Geraes, to operate the Itabará de Matto Dentro iron mines. Part of the railway near at hand is also being electrified. Progress was made with the electrification of 22 kilometres of double track road of the Central Railway of Brazil, from Rio de Janeiro to Deodóro. It was decided to use electric traction on this road as far as Barra-do-Pirahy. Recent investigations of the Brazilian Government showed that the waterfalls of Brazil can be used to produce electric power in excess of 30 million horse-power.

In Chile the city of Antofagasta was granted a three-years' concession for the placing of electric signs in some of the principal streets, the concessionaire paying the city 20 pesos monthly for each sign erected.

Work was commenced upon the installation of electric light in the city of Buga, in the Department of Valle del Cauca. A contract was signed for the provision of underground cables to supply Santiago with additional electric light and power, current being brought to the capital by an overhead line from the Central Hidro-Electrica de Puente Cristo, a station at some considerable distance.

In Costa Rica, the Cartage Light & Power Co. was authorised to increase its electric output to 67,500 h.p., the company agreeing to pay to the Government 1 colón (2s.) per horse-power annually. Congress recommended that the municipality of the Canton of Santo Domingo should raise the necessary funds for the establishment of a hydro-electric light and power plant.

A decree was issued by the President of Cuba for the establishment of a factory for the making of electric lamp bulbs, to be erected at the capital, Havana. The most important electrical installation in Latin America was completed at Havana in June, when the new installation of the Havana Electric Light & Power Co. put into operation its new electric generating plant to take the place of the three old and inadequate power stations then in operation. A modern service station for the prompt repair of all kinds of electrical machinery was established in the capital.

In Ecuador, the Municipal Council of Ibarrá authorised the installation of electric plant for a public and private light service in the city, power being derived from waterfalls near at hand. A new electric light installation was established at Guayaquil, the system consisting of 100 and 150-c.p. lamps, with special shades projecting the light into the street. Diesel sets were installed, and these now render it possible to furnish all the light needed at a smaller cost than that of the former system of city lighting. The Canton of Puebloviéjo was authorised to construct an electric light and power plant.

Electric lighting plants were erected by the municipalities of Nuévo Progréso and Sololá, in Guatemala. The Government called for the construction of an electric railway line from the city of Guatemala to Antigua. The municipality of Cuyotenango contracted for the installation of an electric light and power plant.

In Haiti, a contract for the lighting of Port au Prince and Cape Haitien was given to a new Haitian company with a capital of £50,000 ($250,000). The municipality of Cayes made arrangements for the installation of an electric plant in that town.

In Honduras, the largest electrified sugar-mill yet constructed in Central America was commenced at La Lima, power being developed by a 1,000-h.p. turbo-generator set, with an auxiliary 200 kW set for lighting and general purposes. The electric installation will be at 440 volts, 60 cycles, provided by a Curtis steam turbo-alternator, at 3,600 r.p.m. The New York and Honduras Rosario Mining Co. obtained a contract from the Government to divert the waters of La Tigra cañyon to the Jutiapa reservoir, the water being used in operating an electric light and power plant at La Leóna.

The Mexico Light & Power Co. was given permission by the Minister of Promotion to construct two additional plants below its present works at Necaxa. Work upon one installation will occupy eighteen months, and upon the other three years. When both are in operation they will supply 30,000 h.p. daily in addition to the 67,000 h.p. which the company already controls. The Compañia de Luz y Fuerza Electrica was granted a concession to construct an 80,000-h.p. electric plant in the State of Michoacán, while an American company commenced the erection of an electric plant in the State of Puébla, utilising a waterfall furnishing 70,000 h.p. The electric street-car company of Tampico (Tamaulipas) commenced the construction of a new line to run through the principal parts of the city. An electric plant in the State of Chilpancingo was commenced.

A careful study of Peru's hydraulic resources was made by order of the Government, when it was found that, at a modest estimate, the potentiality amounted to 15,000,000 h.p. The total capacity of the present electrical plants does not exceed 52,000 kW, of which nearly 41,000 kW comes from waterfalls.

In Santo Domingo, the municipalities of Santiago and Puerto Plata purchased the Compañia Anónima Dominicana de Luz y Fuerza Motriz, which supplies the cities with light and electric power.

Material was purchased in the United States for an electric light and power plant to be installed in the city of León, Republic of Nicaragua.

The town of El Refugio, Republic of El Salvador, completed a contract with the electric lighting company of the city of Chalchuapa for an installation. A contract was signed for the establishment of an electric light and power plant in Suchitoto, Department of Cusclatán. The electric tramway between the city of San Salvador and Santa Ana was converted from mule to electric traction, six electric cars having been purchased.

The President of Venezuela issued a decree assigning an additional credit of 5,000,000 bolívars for public works, to include a number of electric installations. The municipality of Carorá concluded a contract for the installation of an electric lighting plant in that community at a cost estimated at 160,000 bolívars.

2. *New Wireless Telegraph and Telephone Installations.*

A credit of 300,000 pesos was voted by the Argentine Congress for the equipment of army telegraph companies with wireless telegraph apparatus. A concession for thirty years was granted to a French company, which commenced the installation of a high-power wireless station to establish communication between Argentina, France, and other countries outside of South America. A continuous-wave system, using 800 or more kW of oscillating energy, will be employed. The Government issued a compendious volume embracing all the laws.

rules, regulations and rates for telegrams and radiograms, national and international, including the names of the telegraph offices of Bolivia, Chile, Uruguay, and Argentina.

A wireless concession was given to the Radiograph Co. of Brazil to install and operate high-powered radio stations of the most modern types for direct communication with the Americas and Europe. The concession is for forty-five years, but it grants no monopolies or privileges, confining the business to international service, while messages to local points within national territory are prohibited. Work was commenced upon the first two stations in Rio de Janeiro and Belém, State of Pará.

The first wireless telephone communications in Chile were held between the University of Chile and the School of Medicine, over a distance of several miles. The instruments used were of the same type as the wireless telegraph instruments employed by the Germans in the trenches, since adapted to wireless telephony. A wireless telephone system was decided upon for the whole of Chile. A wireless service was established between Santiago and Valparaiso in April, thus overcoming interruptions in the use of the telegraph lines during the winter months.

A radio-station was completed by British engineers at Puerto Colombia (Republic of Colombia) in connection with the contract made by the Government with the Marconi Co.

Costa Rican electrical engineers were granted a 25-year concession to erect and operate in Port Limón, or other points of the Republic, one or more wireless telegraph and telephone stations, powerful enough to communicate by wireless directly, or through a third station, with one or all of the stations of the United Fruit Co. The concessionaires will erect auxiliary stations at San José, El Poso or Golfo Dulce, and Puntarénas.

Concessions were granted for wireless telephone services in Cuba between the principal cities under the stipulation that the installations should be completed within five years. The installation of a wireless telephone system was authorised in Caibarien, Cayo, Frances and Punta de San Juan, a station being erected in each place.

A commercial wireless service was established between the Canal Zone, Panama, Colombia, Venezuela and Ecuador. The charge per word from Balboa to Cartagena is 22 cents (gold), if transmitted in Spanish, and 24 cents (gold) per word in English or coded.

A wireless telegraph service was established between the city of San Salvador (Republic of El Salvador) and the wireless telegraph office of the Republic of Guatemala, messages being charged at the rate of 10 centavos-de-colón per word.

A wireless station was commenced on the María Madre Island, in the Pacific Ocean, west of the Territory of Tepic (Mexico).

A cable was laid across the Alto Paraná, Paraguay, from the vicinity of Encarnación to an Argentine town near Posadas, thus affording telegraph communication for the first time between the two countries (Paraguay and Argentina).

A wireless station was set up and put into operation at Ilo, the most southern part of the south coast of Peru.

In Uruguay the meteorological institute commenced preparations for installing apparatus for transmitting time signals by wireless—the first of its kind in South America—using the system employed during the war with excellent results, the contact passing directly from the pendulum to the antenna. Preliminary trials proved a range of 9,800 kilometres, but at any time signals from the institute may be received at 3,400 kilometres.

The Government of Venezuela arranged for the installation of 22 wireless stations in the Republic. The installation at Maracay was completed, and contracts were concluded for the erection of wireless towers at San Cristóbal, Maracaibo, Puerto Caballo, Coro, La Guaira and Ciudád Bolívar. A School of Wireless Telegraphy was founded at the capital, Caracas, under governmental decree. The Maracaibo station will have a power of 5 kW, a radius of 500 miles during the day, and 1,500 miles during the night. The towers will be 50 metres high, while the stations will be able to get into direct communication with the Arlington Station in the United States, and the station at Colón, Panama. The station at Maracay was to have been completed in December, while by the same time a third station was to have been installed at San Cristóbal.

REVENUE FROM POWER SUPPLY AT LIGHTING RATES.

By "INTERESTED."

How many engineers or managers of electricity supply undertakings have taken the trouble to figure out the number of installations connected to their mains which have no separate power circuits, and yet have in commission power-consuming apparatus? Also, how many other ordinary consumers of electricity for lighting only would be pleased to use an electric iron, small hotplate, bedroom radiator, &c., provided such apparatus were offered on favourable hire-maintenance or hire-purchase-maintenance terms?

Quite recently a small consumer requested my advice regarding the advisability of having a separate circuit for two bedrooms in which small radiators were in use a few minutes night and morning during the winter months. The statement showed as follows:—

Two 1-kW radiators each in use half-an-hour per day	1 unit per day		
Five months (say 150 days)=150 units, at 7d. per unit	£4	7	6
Cost of wiring separate circuit, plugs, &c.,	2	5	0
150 units, at 2½d. per unit	1	11	3

The decision arrived at by the consumer was that the trouble of running the mains was not worth the small saving shown, even in view of the larger saving in following years, and that more care would be exercised in future as to the length of time the radiators were in use. Now, that feeling is like that of many others, who express their willingness to pay lighting rates for small electricity-consuming devices rather than worry about a separate circuit with the attendant mess of workmen about the house.

When such conditions exist, what an excellent source of revenue is awaiting the engineer who pushes the hire-maintenance scheme for small apparatus. The figures in a district having about 6,000 consumers show something like the following:—

One iron in 50 per cent. of the houses connected to mains, in use an average of two hours per week; 48 weeks per annum=144,000 units at, say, 7d.=	£4,200
One hotplate, in 25 per cent. of the houses connected to mains; in use an average of three hours per week: 30 weeks per annum=67,500 units, at 7d.=	£1,968
One bedroom radiator, in 25 per cent. of the houses connected to mains; in use an average of three hours per week: An average of 20 weeks per annum=45,000 units, at 7d.=	£1,312

Also, a few small fans during warm weather, and perhaps toasters, curling tongs, or shaving-water heaters would bring the possible revenue up to £8,000 per annum—at least £4,000 profit after allowing a fair sum for maintenance. The actual profit would be greater, because the demand would chiefly come at the time of "off-peak" load. Necessarily capital charges enter into the calculations, but complete provision could be made for these by a properly-arranged schedule of charges on the hire-maintenance or hire-purchase system, estimated according to the useful life of the various apparatus, which should not be difficult where detailed records are available, as they should be in every undertaking.

Profit cannot be expected from a few isolated installations: business should be catered for on a large scale. Such possibilities are feasible and practicable, provided the apparatus is well advertised throughout the district, on the hire-maintenance system. The present season affords an admirable opportunity to press forward these labour-saving appliances of small consumption. Picture postcards showing the interiors of bedrooms having small electric fires throwing out radiant heat would bring in many customers when the weather was cold. Again, good-class circulars properly designed, illustrating these various articles, can suggest New Year's gifts, especially when a carefully-guarded note is displayed, mentioning the fact that such goods can be used from an ordinary lamp-holder. Advertisements should not contain too much letterpress.

Sufficient has been said to show the possibility of selling power at lighting rates, with advantage to the consumer. The contractor is the man with the best opportunity for pushing such a scheme. Would not supply authorities welcome the opportunity of joining with local contractors in promoting an intensive and extensive campaign on some such lines as suggested, which offers mutual benefits?

THE NEW CLERKENWELL TELEPHONE EXCHANGE.

Condemnation of certain of the methods by which the telephone service is conducted continues to be indulged in, but while the "threats of innumerable subscribers to discontinue their agreements" of service are attributed to the so-called "prevailing discontent," the real state of affairs may be gauged by the fact that the General Post Office authorities continue to find themselves compelled to spend large sums of money, not merely with the laudable object of improving the service, but in evident anticipation of a large extension of business.

Only a few weeks ago a new London telephone exchange was completed, and quietly assumed its functions without public attention being attracted to it. It is known as the Clerkenwell Exchange, and is said to be the largest and most complete of the nine exchanges that have been equipped in London since the Armistice; and, in addition, a number of existing exchanges have been extended and many relief exchanges have been established.

The new exchange is housed in a building that was specially erected for the purpose, and will serve the Clerkenwell, Shoreditch, Finsbury, and Charterhouse areas, all of which formerly found relief in the temporary exchange that was accommodated in the same building. The relief exchange will now be made use of to assist the Bishopsgate area, pending the completion of another large exchange which is projected and which will be named after that district. The London temporary, or relief, exchanges have rendered good service, and it is of interest to note that the equipment with which they were built had during the war period been used in various Government establishments.

Owing to difficulties having been experienced in securing the necessary materials and plant, it took nearly two years to construct and erect the equipment, all of which work was undertaken by the Peel-Conner Telephone Works, Ltd. (proprietors, the General Electric Co., Ltd.), but in normal circumstances such an exchange can be completed in from six to nine months. The inauguration of a new exchange in an existing telephone area involves extensive rearrangement and modification of the cabling under the streets; this outside work was done by Post Office employés, and some of the cable jointing is very complicated.

The new permanent establishment commenced its existence with approximately 1,600 subscribers, most of which were transferred from the relief exchange, but it provides accommodation for about 7,100 subscribers'

Fig. 1.—General View of Switchboard Room.

lines, and has been designed for an ultimate capacity of 10,000 lines. The switchboards and auxiliary apparatus are of the most up-to-date type, though all the equipment is of standard design. A view of two-thirds of the switchboard room is given in fig. 1; the boards that have been so far installed will need some 135 operators when they are fully engaged, and it will be seen from the illustration that the subscribers' switchboard is

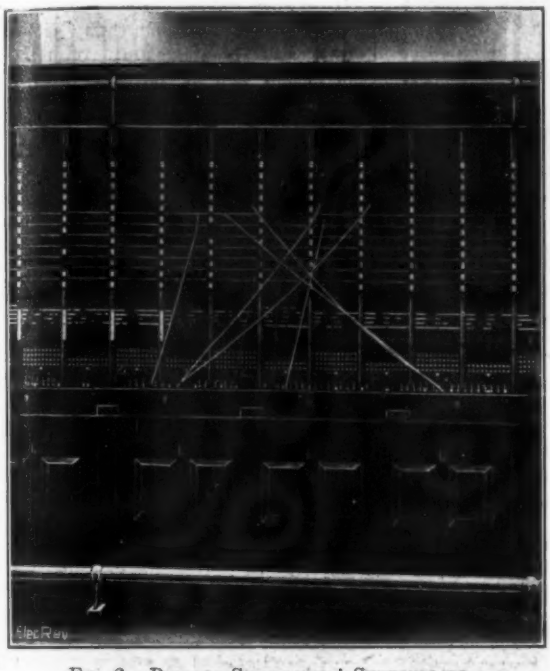


FIG. 2.—PART OF SUBSCRIBERS' SWITCHBOARD.

ranged along the left-hand side of the room, while the junction board is placed on the right. At the far end of the room an electrophone distribution board is provided, and the centre of the apartment is occupied by the information and supervisors' desks; a close up view of part of the subscribers' board is shown in fig. 2.

On the floor below are the test, machine, and battery rooms; the last contains two 40-volt batteries each composed of 20 L.S.H. 41 type cells supplied by the D.P. Battery Co., Ltd., each being of 3,055 ampere-hours capacity, or capable of an ultimate capacity of 4,277 ampere-hours when discharged at the rate of 1.85 amperes for nine hours. The plates are contained in lead-lined teak displacement tanks, to which more plates and electrolyte can be added when it becomes necessary to increase the size of the battery. A special hydrometer float is utilised in each cell for the purpose of obviating the surface effect when readings are taken.

A view of the power plant is given in fig. 3; in the centre of the picture can be seen the machine and battery control board, and on the left are the two telephone line fuseboards, between which a portion of the junction repeating coil and condenser rack can be discerned. The diminutiveness of the fuses makes them of interest; they are ranged on the board in vertical rows, and when one blows a small bead, which is attached to the fuse by a coiled spring, jumps out and, in addition, a lamp is lighted and an alarm bell rung so that the defective fuse is easily located.

All the power plant illustrated in fig. 3 was supplied by Messrs. Crompton & Co., Ltd.; the two large duplicate machines are used to charge the battery of accumulators, and consist of shunt-wound, 55-h.p., 530-volt, d.c. motors, which drive at a speed of 850 r.p.m., d.c., 36-kW, 40-volt generators. The smaller machines on the right of the illustration are used for telephone ringing purposes; one is a motor-generator set that is driven by means of the exchange battery; the other comprises an a.c., single-phase, 50-cycle, 105-volt, 0.8 b.h.p., 950 r.p.m. motor, belt driving a d.c., 4-ampere, 75-volt, 1,000 r.p.m. ringing machine. All the driving motors are fed by duplicate cables from the public supply mains in order to provide against a failure of the supply.

At the opposite end of the room is the test switchboard, fig. 4, by means of which all faulty lines are located and rectified; it naturally forms one of the most important positions in the exchange.

The distribution and other frames are placed parallel to each other in the centre of the room. From the cable chamber the paper-insulated lead-covered cables, each containing 1,000 pairs of conductors, are carried up to the floor level of the main distribution frame; each then divides up to form five 200-pair lead-covered cables, which are carried to the base of the main frame over which the silk and cotton-covered conductors are distributed and jointed to the fuse mountings, 20 per strip, both sides of each line being fused to guard against any disturbance that may originate outside the exchange. On the reserve side of the main frame are mounted the heat coils and lightning arresters, the function of which is obvious. Part of the intermediate distribution frame is shown in fig. 5; between it and the main frame and parallel to them are two racks that serve to mount the line relay gear. Lastly, the fifth rack, part of which is also shown in fig. 5, carries the subscribers' meters. The counting train of each meter is revolved by means of a ratchet mechanism that is operated by a solenoid; another set of meters is installed in the switchboard room above, two meters being allocated to each operator, one of which records the effective and the other registers the ineffective calls made by her.

The connecting cables between the different parts of the exchange are carried on wrought-iron runs that are suspended from the roof, as shown at the top of fig. 5; this illustration conveys a good idea of the complicated nature of the wiring and cabling arrangements in a telephone exchange. To give some idea of the amount

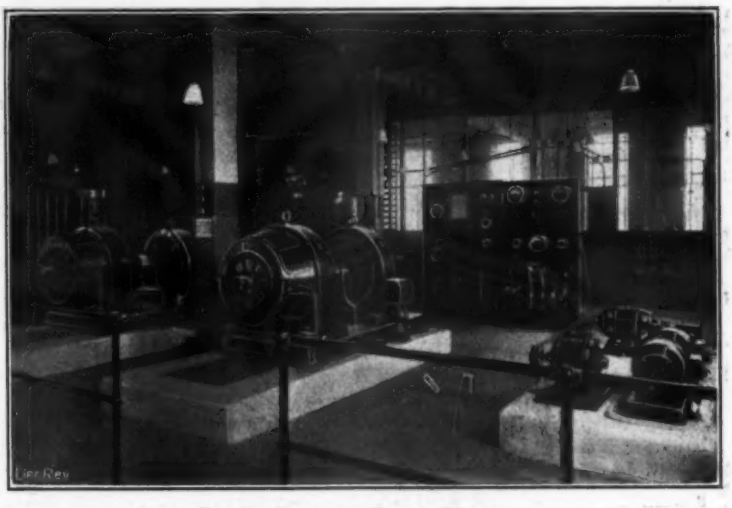


FIG. 3.—CROMPTON POWER PLANT.

of work and material involved, it may be stated that at least 3,000,000 soldered joints had to be made in wiring the switchboards and apparatus. The length of cable used inside the exchange amounted to approximately 153,571 ft., the number of conductors in each cable averaging from 11 to 170; in addition, something like

60,585 ft. of single power leads were used, besides at least twice that amount of the latter type of wire that was needed in assembling much of the apparatus at the manufacturer's works prior to its installation in the exchange. The main multiple run comprises 355 main cables, but the multiplication of the multiple gives a figure of 10,215 for the subscribers' board, meaning that each of the cables is repeated 40 times, except one which is repeated 35 times; the number of multiples would, of course, be increased on the capacity of the exchange being enlarged. The apparatus is mounted in vertical rows so that by increasing the horizontal length of the racks and frames, extensions can be easily carried out.

FIG. 4.—THE TEST SWITCHBOARD.

The adoption of the 40-volt system, the higher pressure being more suitable for use with long lines of comparatively high resistance, instead of the old 24-volt one, enables greater uniformity of transmission to be obtained than is possible with a lower voltage, while it also renders it unnecessary to employ a supplementary battery to operate the meters, as is the case with other systems. A further advantage of the use of a higher pressure is the possibility of using relays having a larger number of turns, thus providing sensitiveness and reliability of action and at the same time reducing the quantity of apparatus required in many of the circuits.

The exchange is well lighted and heated, and careful thought was given to the protection of the apparatus against fire. The comfort of the staff has not been overlooked, and the usual provision has been made for dining-room, rest-room, and cloak-room facilities, in addition to the necessary office accommodation. The exchange comprises only a small part of the efforts that are continually being made to improve the telephone service, but it serves as an excellent example of the enormous amount of work that is involved in any such undertaking.

In conclusion, we have to express our indebtedness to Sir W. Noble, chief engineer, G.P.O., for permitting the publication of the above particulars and illustrations, and to those members of the G.P.O. and the Peel-Conner Works staffs who facilitated the preparation of this article.

FIG. 5.—PARTS OF INTERMEDIATE DISTRIBUTION FRAME AND SUBSCRIBERS' METER RACK.

THE STIFFNESS OF POLES FOR OVERHEAD TRANSMISSION LINES.

By GOWER B. R. PIMM, Assoc.M.Inst.C.E.

In the design of poles for overhead transmission lines the strength in the direction transverse to the line is determined from definite assumptions laid down by regulations, but the strength in the direction of the line is a matter with regard to which there is considerable diversity of opinion.

The forces transverse to the line are quite definite in character if not in magnitude, and can be expressed as a function of the exposed surface of poles plus wires.

The longitudinal forces, on the contrary, are varied and complex, and can be summarised as follows:—

1. Bending and torsional forces due to accidental breaking of wires—a function of weight of wires.

2. Pressure of wind blowing along or obliquely across the line—a function of exposed surface.

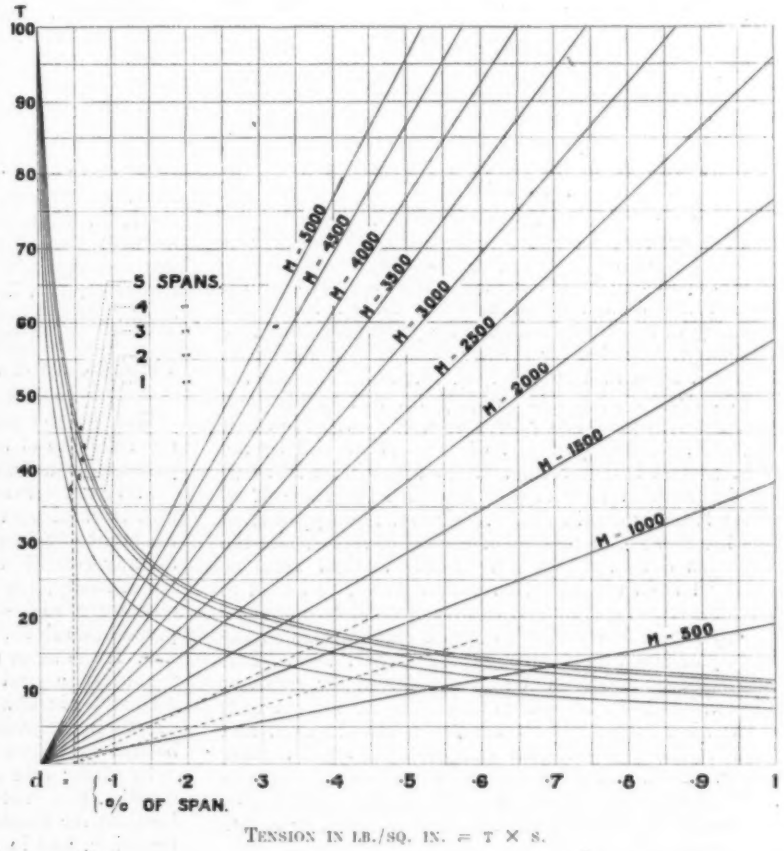
3. Inequality of thermal expansion in adjoining spans of unequal lengths—a function of length of span.

Of these forces, the first-named are by far the most important and the most difficult to calculate. We will therefore deal chiefly with these bending forces due to broken wires, first briefly indicating what modifications may have to be made in respect of the other forces.

Torsional forces, if unbalanced, *i.e.*, if more wires break at one end of the arms than at the other end, relieve the bending strain on the pole, but the actual torsional stress may be considerable, particularly if light lattice, tubular, or A-poles are used. With reinforced-concrete poles it is unnecessary to make special provision for the torsional stress, as they invariably possess ample torsional strength.

The effect of changes of temperature on adjoining spans of unequal lengths is to produce a bending strain in the pole, this strain being towards the long span for temperatures above the normal, and towards the short span for temperatures below the normal, the rate of change of tension with regard to change of temperature being less in the long span than in the short one. If the difference of length is considerable, therefore, the pole should be stayed fore-and-aft.

We now come to the bending forces and unbalanced tensions at insulators due to broken wires, and these can be found by direct calculation, but it is a somewhat laborious process. The annexed diagram has therefore been prepared for the purpose of calculating these forces and their effect.



TENSION IN LB./SQ. IN. = T × S.

The symbols used have the following meanings:—

a = Sectional area of one wire (sq. in.).

A = Total sectional area of wires in unbroken spans (sq. in.).

d = Deflection of pole adjoining broken span (per cent. of span).

L = Length of each wire in span (feet).

M = Deflection modulus of poles = P/W = p/d . S . W.

N = Number of spans between broken span and more distant end of section, afterwards referred to as "the number of unstayed spans."

p = Pull on pole when deflected d . x . S feet (lb.).

P = Test load which would cause 1 ft. deflection of pole (lb.).

S = Original length of span (feet).

t_0 = Tensile stress intensity in broken span (lb./sq. in.).

t_1 = Tensile stress intensity in first unbroken span (lb./sq. in.).

T = Tension value in diagram t_1 = T × S.

v = Dip in feet.

w = Weight per linear ft. of one wire (lb.).

W = Aggregate weight per linear ft. of wires in unbroken spans.

x = Number of wires in unbroken spans.

y = Number of wires remaining intact in broken span.

The meaning of M can be more clearly expressed in words than in symbols. A pole with M = say 1,000 is a pole which would be deflected 1 ft. by a horizontal load of 1,000 . W lb., or it would be deflected d . S ft. by a load of 1,000 . d . S . W lb.

By stating the deflection modulus in terms of d, S and W, each value of M applies to every case in which the ratio P/W is the same, quite irrespective of the actual values of P and W.

In the diagram, M gives the relationship between deflection of pole and unbalanced tension at insulators. The intersections of M and N connect this relationship with the number of consecutive unstayed spans.

The curves were calculated from the formula—

$$t = L \cdot S \cdot W/8v,$$

this being a modification of the formula—

$$t = S^2 \cdot W/8v,$$

L being the length of copper wire calculated as a true catenary at 10,000 lb./sq. in. tension. The results do not differ appreciably from those obtained by using catenary formulæ throughout, and are much more accurate than would be given by the formula in its usual form.

Now, whether the deflection of the first pole from the

broken span is restrained by unbroken wires in the broken span, or whether the only restraint is that due to its own stiffness, there is for every deflection of this pole a corresponding tension in the adjoining span, and this deflection and tension are determined by the values of N and M, that is, by the number of spans between the broken span and the stayed pole, and by the stiffness of the poles. If there is no restraint from unbroken wires, the deflection will be such that the tension in the first span and the pull of the first pole are equal. By a process of plotting the unbalanced tensions at the first pole for various values of M and d and for various numbers of spans, the deflections at which the tension and the pull balance have been obtained, and are given in the diagram by the intersections of the proper values of M and N.

Curves for 1, 2, 3, 4 and 5 equal unstayed spans have been plotted. Beyond that number the curves close up rapidly, and can be estimated with sufficient accuracy. Each curve shows the tension in the first span and the deflection of the first pole of the series. The remaining spans and poles need not be considered as the deflection decreases as the stayed pole is approached, and therefore the unbalanced tension at the insulators also decreases—the conditions both as regards poles and insulators being most severe at the pole adjoining the broken span.

The results were first calculated for spans of 100 feet, and are made applicable to greater spans by stating the deflection in terms of the span, and by introducing a span factor into the tension values. This application of the diagram to spans other than that for which it is calculated is based upon the law that in catenaries of the same shape, *i.e.*, the same ratio of dip/span, the tensional stress intensity varies as the span. Now the original tension is assumed to be the same in spans of any length, viz., 10,000 lb./sq. in. Suppose that in a 100-ft. span the deflection of the pole is such that the tension has been reduced to 5,000 lb./sq. in. The catenary will now have the same shape and the same rate of change of tension for further changes of deflection as a 200-ft. span at 10,000 lb./sq. in., and therefore the 100-ft. curves below 5,000 lb./sq. in. will be identical with 200-ft. curves below 10,000 lb./sq. in., but to half the scale. The adjustment of scale is effected by the span factors in the values. Zero deflection will be at the intersection of T × S = 10,000 with the value of N, which is being considered. A vertical is dropped from this intersection to the line of deflection values, and the deflection cut off to the left of this vertical must be deducted from the deflection values found, or added to the deflection values given, and values of M (given or found) are drawn through the new zero parallel to the corresponding values through the 100-ft. zero. This construction is shown on the diagram for spans of 200 ft., but in practice it is much simpler to have only the tension values and the curves on the diagram, and the M values and deflection values on a sheet of tracing paper. The latter is then placed over the diagram with zero deflection at the proper point, and the addition or deduction of the deflection cut off is avoided, or rather is done graphically.

The increased tensions in unbroken spans which correspond to every deflection could also be plotted, but these are more conveniently examined by other methods.

The conditions of equilibrium at the pole adjoining a broken span are given by the expression—

$$p = (xt_1 - yt_0)\, a.$$

If we assume—

1. That all the wires may break, $y \,.\, t_0$ disappears, and the expression becomes $p = x \,.\, t_1 \,.\, a$,
but $p = M \,.\, d \,.\, S \,.\, W$, and therefore $M \,.\, d \,.\, S = t_1 \,.\, A/W$. A/W is, of course, a constant, and S will be known, so our variables are M, d and t_1.

M may possibly be pre-determined by the design of the poles; or d by regulations as to deflection; or t_1 by the permissible unbalanced tension at one insulator. In either case, knowing any one of these, we can find the other two from the diagram, for any value of N. Or, knowing any two, we can, of course, find the other from the equation and find N from the diagram.

If we assume—

2. That y wires will remain intact we shall have two unbalanced tensions at the first pole, viz., t_1 at the insulators of the broken wires, and $t_0 - t_1$ at those of the unbroken wires, and we can design to limit either, but unfortunately not both of these.

Now at minimum temperature t_0 will always be greater than 10,000 lb./sq. in., and at stresses of that order the stretch of the wires is an important factor, which, if neglected, leads to quite impossible results. Allowing for stretch, it is a very close approximation to take the increase in t_0 due to deflection of the pole as being equal to the decrease in t_1, and we can now put values to these in the expression—

$$M \,.\, d \,.\, S = (x \,.\, t_1 - y \,.\, t_0)\, a/W,$$

find from the diagram the value of d corresponding to t_1, and proceed as before to find M for a given value of N, or N for a given value of M.

A single numerical example will serve to illustrate the method of using the diagram.

Example.—A line of 200-ft. spans has every 5th pole stayed fore-and-aft. There are six conductors, each having an area of 0.07 sq. in. and a weight of 0.27 lb. per linear ft. In the test of a pole a deflection of 0.5 ft. (0.25 per cent. of S) was recorded under a load of 1,000 lb. Assuming that all the wires in one span may break, find the resulting load at the insulators of the first pole, and the deflection of that pole.

Here $a = 0.07$, $A = 0.42$, $w = 0.27$, $W = 1.62$, and

$$M = p/d \,.\, S \,.\, W \,. = 1{,}000/0.0025 \times 200 \times 1.62 = 1{,}235.$$

First adjust zero deflection for 200-ft. span. Draw $M = 1{,}235$ through the new zero (or use the tracing-paper method), and follow up M to its intersection with $N = 5$. We find that $T = 17.50$ and $d = 0.375$ per cent. The tensile stress will, therefore, be $T \times S = 17.50 \times 200 = 3{,}500$, and the load at each insulator will be

$$3{,}500 \times 0.07 = 245 \text{ lb.}$$

The deflection of the first pole will be

$$200 \times 0.00375 = 0.75 \text{ feet.}$$

Whether the poles should be stiff or flexible depends upon the size of the wires compared with the maximum permissible unbalanced load at the insulators.

1. If the wires are too small to exert the permissible pull at minimum dip, the poles should be stiff, for in the event of wires breaking there is no need to provide for any reduction of t_1 by deflection of the pole. On the contrary, too much deflection is in this case a disadvantage, as $t_0 - t_1$, may be thereby increased above the permissible limit.

2. If the wires are large enough to exert (at any temperature) a pull exceeding the maximum permissible pull at the insulators, we can design for either the worst or the most probable combination of broken and unbroken wires and balanced and unbalanced arms.

In either case the poles should be strong enough to sustain the sum of the possible or permissible unbalanced loads at the insulators in the event of all the wires breaking, and in case (2) the flexibility of the pole will determine whether the tension is reduced to the necessary extent by deflection of the poles or by slipping of the binders, or breakage or distortion of the insulators or their pins.

The accidental factors affecting the forces in the direction of the line are so uncertain that the above method may perhaps be unnecessarily minute, but it may at least serve as a means of examining the character of these forces if not of ascertaining their exact magnitude.

A New Mineral.—A new mineral with the heating properties seen in radium has been found in the Belgian Congo at Kasolo, Maitre Schoet declared at the Academy of Sciences on December 27th. "Asolite," as it has been called, has a yellow crystal appearance which changes as heat is given out and the metal decreases.—*Daily Mail.*

POWER FACTOR.—IV.

By E. W. DOREY, M.I.E.E.

PREVIOUS articles have dealt mainly with the importance of the improvement of power factor from the point of view of the mains, transformers, &c., outside the consumer's premises, *i.e.*, forming part of the distribution network of the supply undertaking. In many instances to-day supply is given to the consumer at high pressure, it being left to the consumer to install, at his own cost, the necessary transforming plant. The following examples have been worked out to show the importance of improving the power factor on the consumer's premises, with a view to conserving the capital expenditure necessary for the consumer's electrical equipment.

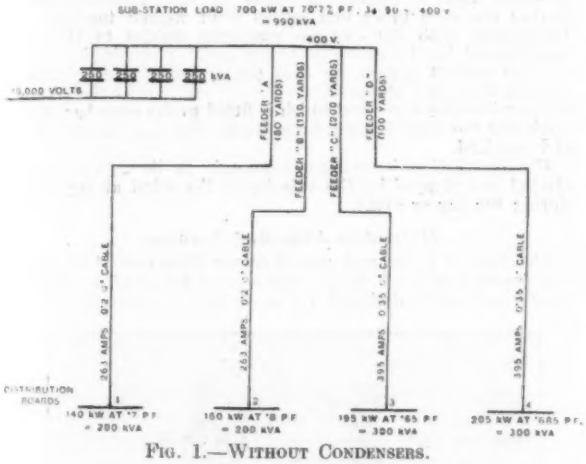

SUB-STATION LOAD 700 kW AT 70·7% P.F., 3ø, 50 ~, 400 v
= 990 kVA
400 V.
250 250 250 250 kVA
10,000 VOLTS
FEEDER "A" (80 YARDS)
FEEDER "B" (150 YARDS)
FEEDER "C" (200 YARDS)
FEEDER "D" (100 YARDS)
DISTRIBUTION BOARDS
140 kW AT ·7 P.F. = 200 kVA
160 kW AT ·8 P.F. = 200 kVA
195 kW AT ·65 P.F. = 300 kVA
205 kW AT ·685 P.F. = 300 kVA

FIG. 1.—WITHOUT CONDENSERS.

Example.—The consumer's load has been assumed to be 700 kW at 70.7 per cent. power factor and taking supply from the mains at 10,000 volts, 3-phase, 50 cycles, this being transformed down by the consumer, at his own expense, to 400 volts for low-pressure distribution.

By the installation of condensers to improve the over-all power factor from 70.1 per cent. to 95 per cent., it is shown that the capital expenditure to be incurred on transformers and mains is very considerably reduced.

(A). *Without Condensers.*—Load 700 kW at 70.7 per cent. p.f.=990 kVA.

(B). *With Condensers.*—Load 700 kW at 95.0 per cent. p.f.=737 kVA. Reduction in demand is therefore 253 kVA.

The diagrams, figs. 1 and 2, show the conditions, first without condensers and secondly with condensers.

Sub-station.—A spare transformer in either scheme has not been included, as it does not affect the comparison.

Scheme 1 requires four transformers each of 250 kVA.

Scheme 2 requires three transformers each of 250 kVA.

By the installation, therefore, of condensers there is a saving of one 250-kVA transformer with its high-pressure and low-pressure switchgear and a correspondingly reduced area of the sub-station. This saving may be taken as approximately £800.

Main Distribution Board.—The main distribution board would have to deal with:—

Scheme 1, a total load of 990 kVA.

Scheme 2, a total load of 737 kVA,

and although the number of feeder switches in either case is the same, the capacity would be reduced considerably with the condenser scheme, for which two 200-amp. and two 300-amp. switches would meet the case, as compared with two 300-amp. and two 400-amp. switches in the case of Scheme 1.

This saving may be taken as approximately £100.

Feeder Cables.—The capacity of the feeder cables, assuming that paper-insulated lead-sheathed and single-wire-armoured cables are used, would be considerably reduced; the saving would be approximately as follows:—

Feeder.	Route Length.	Scheme 1.	Scheme 2.
A.	80 yd.	.2 sq. in.	.125 sq. in.
B.	150 yd.	.2 ,,	.15 ,,
C.	200 yd.	.350 ,,	.2 ,,
D.	100 yd.	.35 ,,	.2 ,,

The total saving in cost under this heading would be, approximately, £110.

Cost of Condensers.—It will be seen that to effect the improvement of power factor four condensers are proposed of 97, 67, 164, and 150 kVA capacity respectively, and the total cost of these condensers may be taken as approximately £2,500.

Saving on Transformers and Feeders.—The total saving on transformers, feeders, &c., as above would be—

Sub-station	£800
Main distribution board ...	£100
Feeder cables	£110
Total	£1,010

Taking, therefore, a round figure of £1,000, it will be seen that the additional capital expenditure necessary for Scheme 2, with condensers, is:—

Cost of condensers	£2,500
Saving on transformers, &c. ...	£1,000
Net additional expenditure ...	£1,500

Saving if Charged on kVA Demand.—If the consumer is charged on a maximum demand in kVA the equivalent of £4 per kVA per annum, the result will be as follows:

Demand without condensers ...	990 kVA
Demand with condensers ...	737 kVA
Reduction in demand	253 kVA

253 kVA at £4=£1,012 per annum.

In an instance such as this, therefore, for a net expenditure of £1,500 the consumer saves no less than £1,012 per annum, which is 67.5 per cent. per annum, and therefore a thoroughly sound commercial proposition.

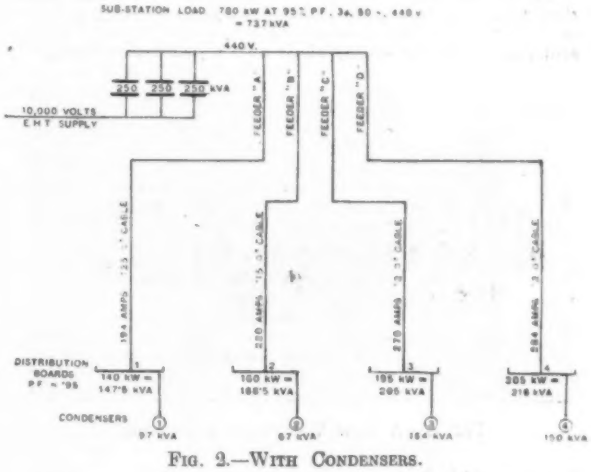


FIG. 2.—WITH CONDENSERS.

It may be argued that the figures given above are somewhat fictitious, and that when laying out a works a margin is always allowed for future extensions; whilst the author would be the last to contradict the latter statement, it must be borne in mind that the comparison given above holds good whether a margin is allowed for future extensions or not. Again, the consumer is

often faced with the difficulty of trying to add a further two or three hundred kVA of load on existing mains, transformers, &c., and a simple and effective solution would be found by the installation of static condensers at the ends of the works' feeders in the manner indicated in Scheme 2 above.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Time-lagged Light.

The *Electrical News* (Toronto) recently described a device made by the TERMONT PRODUCTS Co., 216, High Street, Boston (Mass.), for causing a light to stay "on" for a minute or so after switching off, thus giving one time to get into bed or out of a room without injuring oneself or the furniture. The object is accomplished by means of a thermostatic

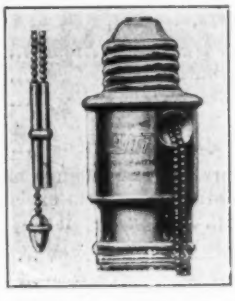


FIG. 1.—A "TIME-LAGGED" LAMP SWITCH.

switch mechanism, fig. 1, acting as a sort of spring latch, which, when cool, holds together two ordinary spring leaf contacts, but when heated, moves slowly to a position which releases the contacts and breaks the circuit. The heating of the thermostat is accomplished by pulling a grip piece on a double socket chain. One end of this chain passes through the grip, and is used for switching the lamp on.

Wind Power for the Generation of Electrical Energy.

In our issue of April 29th last, we described and illustrated the system of automatic high-speed wind dynamos placed on the market by MESSRS. F. A. WILKINSON & PARTNERS LTD., of Hatfield, Herts. This system has now been improved by the adoption of a new type of dynamo, illustrated in fig. 2.

The present improvement, which is a very vital one, consists mainly in the employment of a dynamo having a field-magnet system which rotates in the opposite direction to the armature under the agency of its own separate direct-coupled

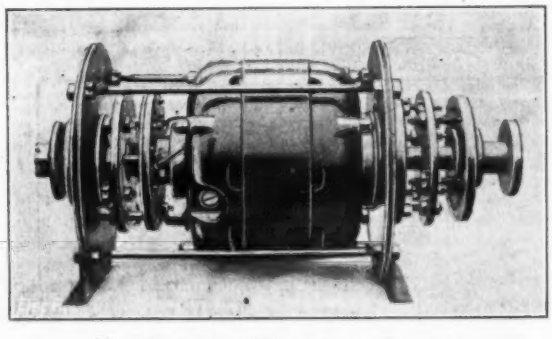


FIG. 2.—A NEW WIND-DRIVEN DYNAMO.

impeller. This is found in practice to result in an output very considerably greater than that obtainable from an ordinary rotating-armature dynamo of the same size.

Each dynamo is rated at 100 watts, and battery charging is commenced in winds of 15 miles per hour, the output and speed increasing with the velocity of the wind. The dynamos, of efficient design, have laminated fields and are self-regulating for battery-charging purposes. They are of the ventilated type, and are enclosed in steel cases. Ball bearings are fitted to both the armature and the revolving field-magnet system, the lubrication of the machines thus requiring but little attention. To enable the rotating connections of the armature and field magnets to be readily coupled up to the battery, each dynamo is provided with a multiple contact plate and a terminal board upon which carbon brushes fitted in spring holders are mounted.

A feature of the system is an automatic cut-out which requires no electrical energy for its operation, the connection and disconnection of the dynamos to and from the battery being automatically effected and governed by the velocity of the wind, thus saving some three to four watts required by the usual type of automatic cut-out.

One of the dynamos of the installation is arranged as a "control" dynamo, and is the one shown in the illustration. Upon its armature shaft is fitted a sleeve free to move in a lateral direction and upon which is mounted a contact plate having its central portion arranged with a housing to receive a ball bearing. A terminal board fitted with adjustable contact fingers is attached to one of the end plates of the machine. When the velocity of the wind is sufficient, the contact plate is forced against the contact fingers, making the necessary connection between the dynamos and battery and conversely breaking the connection when the velocity of the wind falls below a predetermined value.

The standard installation comprises three wind dynamos mounted upon a tubular cross-bar of robust construction, having the steel tubes and swivel head welded together at the centre, with the dynamo platforms welded to the extremities of the tubes. The swivel head is provided with a circular contact system, so that the cross-bar and dynamos are free to move continuously in one direction under the agency of the wind direction vane which is fitted to the cross-bar, thus obviating the necessity of flexible wiring between the cross-bar and standard.

The installation is entirely automatic in its action, being started and stopped by the velocity of the wind at any time during the day or night.

Metal-strip Annealing Furnace.

The firm of AUTOMATIC AND ELECTRIC FURNACES, LTD., 281-283, Gray's Inn Road, W.C.1, has sent us details of an electric muffle especially designed for continuously annealing thin

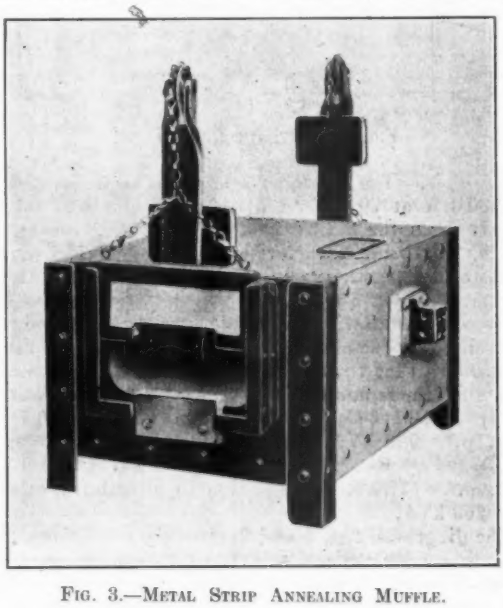


FIG. 3.—METAL STRIP ANNEALING MUFFLE.

metal strip. The muffle consists of an outer casing of aluminium plate riveted to angle iron pieces running horizontally and vertically, the four vertical members forming the legs. Iron castings are used for the back and front. The doors at both ends, as will be seen in the illustration (fig. 3), are of the semi-balanced type, made of a special non-conducting heat material, mounted in a light angle-iron frame, and sliding in frames of similar material with chains passing over pulleys, the other end of the chains being connected to counter-balance weights. This arrangement permits of an easy adjustment of the doors to suit the varying thicknesses of metal strips. The electrical equipment consists of the firm's "flat" type muffle chamber wound with a special high temperature wire suitable for 1,000 deg. C. The temperature of the chamber is adjusted by a regulating rheostat. The consumption of the muffle is only 1.5 kW, and with this loading a temperature of 830 degs. C. is reached in about one hour.

An Electrical Bed-Warmer.

THE SOUTHERN ELECTRIC Co., Simplex House, St. George's Park Avenue, Westcliff, Essex, has sent us a sample of its "Simplex" bed-warmer. This consists of a metal container of elliptical section, surrounded by a double fabric bag. In one end is fitted a bayonet lamp holder, into which is fixed a metal-filament lamp of from 15 to 25 c.p. A test shows it to be efficient and economical.

LEGAL.

Wrongful Connection to Mains, and Assault.

On December 30th, Messrs. Williams & Williams, Reliance Works, Chester, were summoned by the Chester Corporation for unlawfully connecting wires to the Corporation electricity mains, and also for assaulting Mr. S. E. Britton, the Borough Electrical Engineer. The defendants entered a cross-summons against Mr. Britton for assault.

For the Corporation it was stated that defendants were consumers of electricity supplied by the Chester Corporation. Towards the end of November the Corporation proceeded to take a supply of electricity from Queensferry, and, to bring about a change in the supply, a number of firms, including the defendants, were informed that it would be necessary to cut off the supply for a short time. Subsequently two of the partners of the firm obtained a concession from the Corporation, who agreed to give them special light on December 2nd. Mr. Austin Jones, instructed by the Town Clerk of Chester, said that at the very time Messrs. Williams were at the Town Hall soliciting this concession, there were attached to the Corporation's main two wires from the defendants' works, without fuses or a meter. He went on to say that on the morning of December 2nd, when one of the Corporation's electric light officials visited the Reliance Works, he found that a disused main belonging to the Corporation was being utilised by Messrs. Williams. Two temporary cables had been fixed on and passed into the office, where they communicated with the existing main, and the current was taken by the ordinary main to the works. These cables were ordered to be removed, and later Mr. Britton, the city electrical engineer, and two other men went to the works to seal up the box through which the power was being obtained. Mr. Benjamin Williams, it was alleged, endeavoured to prevent their going into the works. The two men, however, were able to get to the box, which they sealed, whilst Mr. Britton stood at the gate. Messrs. Williams then tried to push him out, but did not succeed. Defendants afterwards told Mr. Britton that he could not go through the gate, and if he wanted to get out he would have to climb over the wall, which Mr. Britton did. One of the Corporation's jointers said that the fuse wire which had been inserted was capable of taking five or six times as much current as a normal fuse.

For the defence it was stated that the power had only been wrongfully used for about twelve minutes. Defendants admitted a technical offence to avoid throwing 400 or 500 men out of employment.

For the main offence they were fined £5 and three guineas costs. The charge of assault preferred against Mr. Benjamin Williams was dismissed, but Mr. Jack Williams was fined 10s. and costs. The cross summons against Mr. Britton was dismissed.

ELECTRICAL NOTES FROM INDIA.

(From Our Special Correspondent.)

Some time ago the Calcutta Electric Supply Corporation made a request to the Bengal Government that their licence to supply electricity might be extended for ten years, with the option of carrying on the supply for 20 years thereafter. The Municipal Corporation of Calcutta, presumably with some vague idea of compulsory purchase, opposed the application unless some sweeping concessions were made—the principal being a general reduction in rates, and the removal of the existing surcharge of 15 per cent. Some trenchant remarks are made by H.E. the Governor of Bengal, in dealing with the Calcutta Electric Supply Corporation's application.

The resolution is dealt with by the Governor-in-Council, and appears in the *Calcutta Gazette*.

The Supply Corporation are about to erect one 15,000-kW turbo-alternator, and one 6,000-kW set, both Curtis turbines, supplied by the B.T.H. Co.; so that with moderate luck, they will in the near future be in a position to "secure greater convenience for their customers" and to meet all probable demands for energy.

In referring to the Calcutta Supply Corporation's application, the Governor-in-Council says:—

"The matter with which the general public is mainly concerned is the question of the rates charged for current and specially the surcharge of 15 per cent., which has been levied from the beginning of the present year. It has been ascertained that the Calcutta Electric Supply Corporation's present rates for the supply of electricity are considerably lower than those of any other large supply company, either in England or in India. The Governor-in-Council feels that, if this fact is more generally known, most of the objections raised would be removed. It appears to His Excellency in Council that Government are faced with two alternatives, viz., (*a*) either to refuse the application of the Calcutta Electric Supply Corporation, altogether, or (*b*) to grant, in spite of the protests received, a postponement until 1938, of the next period at which the option of purchase may be exercisable. After a careful consideration of the matter His Excellency in Council is of opinion that the option of the first alternative is likely seriously to cripple the activities and development of the Electric Supply Corporation to the ultimate disadvantage and inconvenience of the general public. His Excellency in Council has therefore decided to grant a postponement until the 20th October, 1938, of the first period at which the right of purchase of the undertaking may be exercised but to make no alteration in the subsequent periods of option and to impose no further conditions. He has no doubt that this decision is in the best interests of the Calcutta public, since the grant of this concession will enable the Electric Supply Corporation to take early measure to secure greater convenience for their customers, and he trusts that they will lose no time in constituting in consultation with the Calcutta Corporation a representative advisory committee which will keep them in touch with the needs and legitimate demands of the public."

A notification giving statutory effect to the above decision will be published in an early issue of the *Calcutta Gazette*.

According to the Engineering Supplement of the *Times of India* for December 9th, Cambay will shortly have a supply of electricity for lighting and power purposes, for the introduction of which this quaint little town is indebted to the Cambay State Administrator, Mr. V. K. Namjoshi, who has made the necessary arrangements for the allotment of a suitable site for the power station, and to Messrs. A. A. Miyaji and Mangaldas C. Vakil, two well-known residents of Cambay carrying on business under the name of Messrs. A. A. Miyaji, Mangaldes & Co., who have financed the scheme. Messrs. B. Das & Co., of Meadows Street, Bombay, are the consulting engineers, and much work has been carried out by Mr. B. Das on the distribution lay-out, and by his partner Mr. S. C. Ghosh who is designing the power house. The order for the complete generating plant and accessories in connection with it has been placed in the hands of Messrs. Mirrlees, Bickerton and Day, Ltd. The generating sets are to consist of two Mirrlees-Diesel oil engines, direct coupled to Mather & Platt dynamos, each generating 66 kW at 460 volts.

REVIEWS.

The Fireman's Handbook and Guide to Fuel Economy. By Chas. F. Wade. Pp. 84,. figs. 29. London: Longmans, Green & Co. Price 2s. 6d. net.

As its title correctly indicates, this is a simple manual for stokers and others who have to do with furnace management and fuel combustion. Throughout the book every endeavour has been made to retain a simple style, but anyone who has ever had to write or lecture to an audience uninformed in the elements of chemistry or physics will realise the difficulty, for it is almost impossible to gain anything like a foothold in any matter of technics without the ordinary preliminary grinding on the top of a fairly sound arithmetical knowledge. The author is a little unfortunate in his definition of heat, which he states "can be measured as to quantity by a thermometer." The thermometer can only measure intensity or temperature, for quantity is only measurable as a product of temperature and heat capacity.

Thus a body does not necessarily feel hot when it contains a quantity of heat, or even an additional quantity above, let us say 75 deg. F., for if the body is water, and 20 units of heat are added to a pound of it, this pound will only have a temperature of about 95 deg. F., whereas the same quantity of heat added to a pound of cast-iron at 75 deg. F. would raise its temperature to about 250 deg. F. The statement as made should be amplified by a suitable reference to specific heat. The definition of saturated steam is correct, if not common. Saturated means heat saturated, not saturated with water, as so many think. This latter form of steam is simply wet steam, and steam will carry just as much water in suspension as it can hold when agitated in the presence of water as hot as itself. Or steam is made wet by losing heat and falling out of the category of saturated. It might be well to state in Chapter III that *inert*, as used in chemistry, means inactive, and signifies the lack of power to make chemical unions with other bodies. Nitrogen does, of course, combine, but its hold is very feeble, and in explosives use is made of this feebleness, for explosives are always nitrogen compounds, which can be shaken into their elements by a more or less sudden shock, as by an explosive cap or by a hammer.

Perhaps it is asking too much to condemn the use of the term "draught pull." The term certainly represents what appears to be the condition of affairs, but it is based on a misconception which it would be desirable to explain away, for there is a great difference between pull and push, and draught is in no sense a pull. It is simply the superiority of a column of cold gas above an equally high column of hotter gas. If draught pulled, the choking of the grate by ashes would be far less destructive of draught than it is, for it is almost only due to grate resistance or the resistance of the fuel, &c., on the grate that any chimney above fifty feet in height is needed.

Properly to understand draught is a great help to the man who would master the art of fuel economy. Chapter VI on flue gases, temperature, and CO_2 is excellent.

If the book has a fault it is that it appears to take it for

granted that things as they are, are the best possible in the world, and it sets out to show how they can be best worked. This is not, perhaps, altogether a fault. The fireman finds a boiler in place, and he has to make the best of it. How can he best be taught the principles which underlie good practice? Must a fireman work it all out by experience, or is it well to instruct him in principles? For example, this little book might lay more stress on furnace gas temperature. One may possess a boiler with arrangements for smoke prevention. Yet smoke is made. Why? But a fireman, like all others, has his limitations, and the whole of steam engineering cannot be pushed into one small pamphlet, of which it can truly be said that practically all its contents are good, and will be helpful to the man for whom it is intended.

Aluminium and Its Alloys. By Lieut.-Colonel C. Grarch. Pp. xxiii.+184; figs. 84, protographs 84. London: Constable & Co., Ltd. Price 17s. 6d. net.

Into the pages of this recently-published volume the author has contrived to pack probably more useful information regarding aluminium and its alloys, their properties, thermal treatment and industrial application than is to be found in any other single work on the subject.

Translated from the French by Messrs. C. M. and H. W. L. Phillips, the original text has been strictly adhered to, with the exception of certain of the appendices, and all conversions from the metric to the English system have been accurately carried out; in some cases both sets of values are given.

In dealing with the alloys, those which seem the most interesting, in that aluminium plays an important part in their composition, are fully discussed, while those alloys in which aluminium is of minor importance receive, comparatively, scant attention.

The volume is divided into two "books." Part I of the first book being devoted to the metallurgy and world's production of aluminium, and Part II to the physical, chemical, and mechanical properties, micrography, preservation, and soldering of the metal. Alloys of aluminium form the subject matter of Book II, in which light alloys for casting purposes, light alloys of great strength, and cupro-aluminiums or aluminium bronzes are respectively dealt with. Analytical methods, reports from various tests, and a paper submitted to the Académie des Sciences by the author on the "Thermal Treatment of Light Alloys of Great Strength" form useful appendices to this comprehensive work, the micro-photographs in which are excellently reproduced.

Aggregation and Flow of Solids. By Sir George Beilby, F.R.S. Pp. xv+256; figs. 106. London: Macmillan and Co., Ltd. Price 20s. net.

Probably no other physicist has added more to our knowledge of the micro-structure and physical properties of solids in various stages of aggregation than has Sir George Beilby, whose work in connection with the subject, extending over twenty-one years, has been embodied in a series of published papers, which are now, for the most part, reproduced in the present volume. When the author commenced his investigations, the electron theory was in its infancy, and little was known regarding the structure of the atom, which was generally regarded as a minute particle separated from contiguous atoms by distances enormously large in comparison with the dimensions of the atom itself.

More recently, however, the X-ray examination of crystals has demonstrated beyond question that atoms are space-filling entities which can be built up into solid aggregates, constituting matter as we know it.

Our latest knowledge of crystal structure is in accordance with the view that the atom is a structure of definite size and shape, which behaves in effect as an elastic solid, and this view has guided the author's observations and conclusions from the outset.

The scope of the work may be briefly defined by reciting the titles of some of the more utilitarian of the published papers of the author, the main facts and figures of which are incorporated in the volume. From the papers most likely to appeal to our readers we select the following:—"The Solidification of Metals from the Liquid State," "The Hardening of Metals," "The Hard and Soft States in Metals," and "The Disintegration of Metals under Alternating Stresses."

The evident care with which the book has been prepared for the press is a credit alike to the author, those associated with him in its compilation, and to the publishers for its production, though we fear its eruditeness will interfere with its sale.

BUSINESS NOTES.

Bankruptcy Proceedings.—E. G. Langsford, electrician, late of 14, Westgate, Burnley.—Receiving order made December 30th on debtor's own petition.

R. A. Depledge, electrical engineer, late 102 (now 53), Frodingham Road, Scunthorpe, Lincs.—Receiving order made December 30th on debtor's own petition.

Company Liquidations.—Planet Electric Co., Ltd.—Meeting of creditors, January 9th, at 52, Tavistock Square, W.C.1.

Tampico Electric Light, Power & Traction Co., Ltd.—Winding up voluntarily. Liquidator: Mr. J. S. Evernden, 47, Parliament Street, S.W. Meeting of creditors January 17th. Particulars of claims to the liquidator by February 7th.

Chilian Electric Tramway & Light Co., Ltd.—Meeting of creditors called for January 18th. Particulars of claims to the liquidator, Mr. J. L. Walsh, 47, Parliament Street, London, S.W., by February 7th.

Watercraft Detachable Power Installations, Ltd.—Meeting of creditors called for January 20th at the office of the liquidator, Mr. C. H. Smith, 84, Colmore Row, Birmingham, to whom particulars of claims, &c., should be sent by March 6th.

Dissolution of Partnership.—Greenwood, Hone & Co., electrical contractors, 46, Malden Road, New Malden.—Mr. H. P. G. Hone and Mr. P. Dayian have dissolved partnership. Mr. Dayian will attend to debts.

Trade Announcements.—We understand that the manufacture of the Kestner patent water-tube boiler in this country has been taken up by Messrs. Ransomes, Sims & Jefferies, Ltd., Orwell Works, Ipswich, who hold the sole licence and selling rights for the United Kingdom, the Colonies and Dependencies, South America, the Dutch Indies, and China. Owing to the high price of coal great attention has been directed on the Continent to the designing of boilers of high economy and high class, and one of the principal workers on these lines has been Mr. Paul Kestner, of Paris, and Lille, whose patent water-tube boiler is manufactured in France at the works of Schneider et Cie., of Le Creusot, and is used in many of the large power stations in that country.

Mr. Noel J. Chatwin, of 162, Hagley Road, Edgbaston, Birmingham, has taken over the business of Messrs. Tatnell and Co., electrical engineers and contractors, together with all assets and liabilities, and he will continue trading under the same name.

The business of Mr. Justus Eck is now being carried on under the title of "Justus Eck & S. Brook." Mr. Brook has been Mr. Eck's colleague for many years. The offices have been transferred from Central Hall, Southall, to Palmer Street, Westminster, to handle the increased turnover. In addition to dynamos, motors, and power transformers, the firm is supplying switchgear up to 400,000 volts pressure, arc lamps, scientific lanterns for gasfilled lamps, electricity meters, and small transformers.

Messrs. Harwell, Ltd., ask us to state that their new address is 28, John Street, Bedford Row, W.C.1, and not 9B, Little James Street, W.C. Telephone numbers unaltered. Telegraphic address: "Arwelidite Holb," London.

Messrs. Baughan, electrical engineers, of Reading, who are having their premises rebuilt, are carrying on business temporarily at 175, Friar Street.

Messrs. Venner Time Switches, Ltd., have opened a branch office at 68, Gordon Street, Glasgow, of which Mr. Kirby Johnson is taking charge.

Messrs. Oswald Record & Co. have removed from Dacre House to No. 17, Victoria Street, S.W.1, which is almost opposite. New telephone No. "Victoria 9125."

The business of Messrs. J. Owen & Sons, of Blackheath, S.E., has been taken over by Mr. T. A. Keating, electrical engineer, of 186, Westcombe Hill, Blackheath.

Messrs. Davis & Timmins, Ltd., of York Road, King's Cross, London, N., have recently issued a complete set of lists of their manufactures, with full-size illustrations, and brought up to date. Copies will be forwarded to the trade on application.

The firm of Davis & Timmins was founded in 1876, and it has specialised in turned work of all descriptions—screws, bolts, nuts, studs, washers, terminals, and all small component parts for electrical work. The works at Wood Green cover an area of several acres, and are equipped with modern automatic machinery, producing accurate repetition work within one-thousandth of an inch. A large stock is held at the stores at York Road, King's Cross, of cable sockets, cable connectors, screws, studs, bolts, nuts, wing nuts, washers, &c., enabling the electrical trade to draw upon many thousands of patterns. We believe that British manufacturers will have little desire to support foreign-made goods of the classes mentioned, bearing in mind these stocks and the high quality of London-made repetition work.

The British Thomson-Houston Co., Ltd., has recently opened a new showroom at 155a, St. Vincent Street, Glasgow. Lighting fittings for factories, public buildings, and houses are displayed and a number of lighting systems exemplified.

Private Arrangement.—WILLIAMS & BEVAN, electrical and general engineers, Aberdare.—The creditors of the above were called together recently, when a statement of affairs was presented, which disclosed liabilities of £1,753, all of which were due to the trade. The assets were estimated to realise £616, or a deficiency of £1,137. The assets consisted of stock £300, and book debts £316. It was stated that the debtors commenced trading some two to three years ago, after leaving the Army. The bank allowed an overdraft to the extent of £700, which had now been reduced to £312, and was secured. The present position was attributed to want of capital, competition, and taking contracts at too low a price. The creditors decided that the estate should be dealt with under a deed of assignment, with Mr. S. E. Clutterbuck, of Messrs. Clarke, Dovey & Co., accountants, Cardiff, as trustee, together with a committee consisting of the representatives of the English Electric Co., Ltd., the General Electric Co., Ltd., and Mr. J. D. Williams, Aberdare. The principal creditors are:—

	£		£
English Electric Co.	331	Haslam & Stretton, Ltd. ...	32
Williams, T. D.	200	British Thomson-Houston Co., Ltd.	54
General Electric Co., Ltd. ...	110	Engineering Equipments Co., Ltd.	22
Simpson & Baker	147	Chloride Electrical Storage Co., Ltd.	21
Siemens Bros., Ltd.	112	India-Rubber, Gutta Percha and Telegraph Works Co., Ltd.	28
Williams, J. D.	79		
McWhirter & Sons, Ltd. ...	65		
St. Helens Cable & Rubber Co., Ltd.	47		

Catalogues and Lists.—THE CAMBRIDGE & PAUL INSTRUMENT CO., LTD., 45, Grosvenor Place, S.W.1. A postcard illustrating the "Cambridge" electrical CO_2 and temperature recorder and a specimen chart.

MESSRS. PERRIN'S, LTD., 15, Catherine Street, W.C.2.—A booklet describing "Indestructible" insulated cables and wires.

MESSRS. HIGGS BROS., Sand Pits, Birmingham.—"Monthly Magazine" for January, giving the usual stock lists of a.c. and d.c. motors and d.c. dynamos, together with notes on ball bearings and other useful and humorous items.

MR. O. N. BECK, 11, Queen Victoria Street, E.C.4.—An illustrated pamphlet giving dimensions and other details of "Artus" adjustable multiple spindle drill heads.

THE SUN ELECTRICAL CO., LTD., 118-120, Charing Cross Road, W.C.2.—Three pamphlets dealing respectively with electric kettles, "Apex" ironclad switchgear, and electric lamps. Illustrated and priced.

MEDWAY'S SAFETY LIFT CO., LTD., Rolt Street, Deptford, S.E.8.—An illustrated booklet giving the names of firms which have installed the company's lifts.

MESSRS. WATSON & SONS (ELECTRO-MEDICAL), LTD., Sunic House, Parker Street, Kingsway, W.C.2.—Bulletin 41 S, illustrating and describing the "Sunic Mark I." deep therapy outfit similar to a set supplied to the Fulham Cancer Hospital, London. Fully priced.

MESSRS. REAVELL & CO., LTD., Ranelagh Works, Ipswich.—Pamphlet No. 101, giving illustrated details of several types of electrically-driven compressors and exhausters.

MESSRS. THOMAS BROADBENT & SONS, LTD., Central Ironworks, Huddersfield.—A well-illustrated descriptive catalogue of automatic centrifugal clutches of a number of types.

MESSRS. JOHNSON & PHILLIPS, LTD., Charlton, S.E.7.—"Transformer Abstracts" No. 3.—This booklet gives details of the final tests which are carried out upon the company's transformers before they leave the works. Tests are made of ratio, copper loss, impedance, insulation resistance, iron loss, magnetising current, flash and over-potential pressures, and heating.

THE HOTPOINT ELECTRIC APPLIANCE CO., LTD., 21, Berners Street, Oxford Street, W.1.—A well-illustrated pamphlet giving particulars of "Hotpoint" electric teapots, percolators, toasters, grills, &c.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 56, Victoria Street, S.W.1.—A well-produced brochure describing the company's works and manufactures. Numerous illustrations are included, and the publication provides an informative guide to an up-to-date electrical business, and an example of quick recovery from the effects of the war.

THE HOOVER SUCTION SWEEPER CO., LTD., 288-292, Regent Street, W.1.—A folder reproducing a number of advertisements announcing a reduction in the price of the "Hoover" vacuum cleaner, for the use of contractors.

Calendars and Almanacs.—A useful blotting contrivance for the desk has been received from MESSRS. HOPKINSON INDUCTION MOTORS, of Seagrave Road, West Brompton, London, S.W.6.

The smallest wall calendar received this year is from the SAXONIA ELECTRICAL WIRE CO., LTD. In some offices wall space is a consideration. The card carries monthly date slips.

The DAVENPORT ENGINEERING CO., LTD., of Bradford, has prepared a serviceable calendar with daily slips for 1922.

MESSRS. R. A. EVANS, LTD., of Prospect Road, Leicester, have issued an artistic calendar with monthly tear-off slips fixed beneath a coloured print, reminding us of the charms of Nature on a lovely "Autumn Afternoon." It will be good company until the winter of our discontent is past.

From MESSRS. HASLAM & STRETTON (ENGINEERING & MOTORING UTILITIES), LTD., of 11, Windsor Place, Cardiff, there has come to hand a wall calendar with monthly date slips. We do not quite know how many times we have studied the face of "Doreen" while we have been writing this short note.

A desk hand-blotter has been received from the MILLWALL ENGINEERING CO., LTD., of 21, Panton Street, London, S.W.1.

MESSRS. W. H. WILLCOX & CO., LTD., of 38, Southwark Street, London, S.E.1, have issued a wall calendar with monthly sheets for 1922.

From MESSRS. FRANCIS POLDEN & CO., LTD., of 56, Cannon Street, London, E.C.4, we have received a wall calendar for 1922. Each sheet contains a month's dates in large figuring, and the remaining eleven months in small type.

MESSRS. R. O'BRIEN & CO., of 66, Mosley Street, Manchester, have issued a neat wall calendar with monthly slips. In the pictorial design are views of the Manchester Royal Exchange, opened last October.

From MESSRS. C. HARRIS & CO., of Strover Street, Gillingham, we have received a wall calendar for 1922, with monthly date slips.

MESSRS. CHARLESWORTH PEEBLES & CO., of 134, St. Vincent Street, Glasgow, have sent us one of the 1922 calendars issued by their principals, the CONDOR LAMP MANUFACTURING CO., of Venlo, Holland, for whom they act as sole agents in Scotland and Ireland. A dozen large stout cards each contain a month's dates and a different photographic view of the works (interior and exterior) at Venlo, showing the various manufacturing, testing and distribution stages through which the lamps pass.

THE MACINTOSH CABLE CO., LTD., of Ashbourne Road Mills, Derby, has sent us a desk pad of squared paper with pages interleaved giving illustrations and brief particulars of its electric cables, line construction work, joint-boxes, &c.

MESSRS. CALLENDER'S CABLE & CONSTRUCTION CO., LTD., of Hamilton House, Victoria Embankment, London, E.C.4, have prepared a very serviceable pocket diary for 1922. A separate section consists of tables of net prices of "Callender" C.T.S. cables, flexible cords, "Kaleeco" fittings, &c. The diary itself contains much useful electrical tabulated and other data.

MR. D. C. BATE, of 16, John Dalton Street, Manchester, has sent us a wall calendar consisting of six two-monthly sheets, each of which has a coloured picture humorously illustrating how rumours sometimes arise.

From MESSRS. W. E. JONES & CO., 23, Queen Street, Deal, there has come to hand a calendar with monthly slips above which appears a coloured picture entitled "The Head of the House," the said head being, of course, a tiny child.

Industrial League Lectures.—The following is the programme of Wednesday evening lectures (7.30 p.m. at the Caxton Hall), from this week until March 29th, organised by the Industrial League and Council:—

January 4th.—Mr. J. E. Tuke, "The Solution of the Unemployment Problem."
January 11th.—Mr. Robert Stelling, "A Fair Day's Work for a Fair Day's Pay."
January 18th.—Mr. Robert Young, M.P., "Use and Abuse of Combines and Trusts."
January 25th.—Mr. F. Hughes, "Conditions of Industrial Harmony."
February 1st.—Mr. Hamilton T. Smith, "The Curse of Work."
February 8th.—Professor A. W. Kirkaldy, "Industrial Unrest. Does it make for Progress?"
February 15th.—Sir George Paish, "Industry and its Relation to Finance."
February 22nd.—Mr. Roy Horniman, "A Proposed Solution to the Transport Problem."
March 1st.—Mr. Hilderic Cousens, "The Purpose of Economic Activities."
March 8th.—Miss B. Voysey, "The Personal Factor in Industry."
March 15th.—Mr. W. Piercey, "Psychology in Industry."
March 22nd.—Rt. Hon. G. N. Barnes, "Some Common Fallacies on Trade and Industry."
March 29th.—Major Isidore Salmon, "The Necessity for Educating the Worker in Industrial Economics."

The Cable Makers' Association.—As from January 1st, 1922, the Union Cable Co., Ltd., Dagenham Dock, Essex, is a member of the Cable Makers' Association.

Catalogues Wanted.—MR. J. C. ELVY, A.M.I.E.E., M.I.E.S., consulting engineer, of 12, Tavistock Street, W.C.2, desires to receive up-to-date particulars of electrical apparatus for all purposes, and lighting equipment.

Manchester Municipal Employés' Wages.—The *Manchester Guardian* reports that the action of the Corporation in reducing the wages of the maintenance workers of the tramway and gas departments by 2d. an hour in the case of the skilled men and 1½d. an hour in the case of the semi-skilled and the unskilled, has been endorsed by the Industrial Court, to which the matter was submitted for arbitration. The Court found that the reductions were justified. The Corporation also reduced at the same time the wages of the maintenance workers of the Electricity Department by these amounts, and this matter has also been referred to the Industrial Council for the industry.

Partial Moratorium in Italy.—A partial moratorium has been established by a decree which again brings into force certain clauses of the commercial code relating to postponements of payment by limited and co-operative companies. The range of companies to which the moratorium may apply is limited.—*Reuter's Trade Service* (Rome).

South African Labour Problems.—A Reuter dispatch from Johannesburg reports that the Chamber of Mines has notified the South African Industrial Federation of the termination of certain wage agreements. The electric power companies have declined to enter into further conferences with the Federation or to discuss the increased minimum rates of pay recently demanded by the trade unions.

Forthcoming Exhibitions.—The following exhibitions are being organised:—

London.—February 27th to March 10th, British Industries Fair; March 1st to 25th, Ideal Home Exhibition; April 11th to 25th, Builders' Exhibition; July 3rd to 14th, London Fair and Market.

Birmingham.—February 27th to March 10th, British Industries Fair; June 15th to 24th, Industrial and Commercial Efficiency Exhibition.

Cardiff.—May to October, Welsh National Exhibition.

Canada (*Winnipeg*).—February 6th to 11th, Motor Show.

Austria (*Vienna*).—March 19th to 25th, International Sample Fair.

Belgium (*Brussels*).—February 18th to 27th, Agricultural Machinery Exhibition; April 3rd to 19th, Commercial Fair.

Brazil (*Rio de Janeiro*).—September 7th to November 15th, Centenary Exhibition.

Czecho-Slovakia (*Prague*).—March 12th to 19th, Samples Fair.

France (*Lyons*).—March 1st to 15th, Spring Fair.

Holland (*Utrecht*).—February 21st to March 3rd, International Fair.

Italy (*Milan*).—April 12th to 27th, International Sample Fair.

Norway (*Christiania*).—April 22nd to May 7th, Electrical Exhibition.

Spain (*Barcelona*).—March 15th to 25th, Samples Fair.

Switzerland (*Basle*).—April 22nd to May 2nd, Sample Fair.

Trieste.—May, International Sample Fair.

Japan (*Tokio*).—March 10th to July 31st, International Peace Exhibition.

Social Event.—On Wednesday evening in Christmas week the staff of the Leatherhead & District Electricity Co., Ltd., met at dinner in the "Running Horse," Leatherhead, and amongst those present were Mr. Morris, of Messrs. Buchanan & Curwen; Mr. May, of the Mid-Surrey Engineering Co.; and Mr. Towers, of the Leatherhead Gas Co. The chair was taken by the engineer and manager, Mr. G. W. F. Horner, and between the toasts instrumental and vocal items were given by the members of the staff.

Copper Production in the Belgian Congo.—At the annual meeting of the Société de l'Union Minière du Haut Katanga, just held in Brussels, it was reported that the company's experimental plant in the Belgian Congo was put into operation in the middle of November last, the capacity of the installation being approximately 100 tons of electrolytic copper per month. It was also stated that the work of prospecting the water-power resources of the district was proceeding, particularly as regards the Rivers Lufira and N'Zilo. It is proposed to first utilise the water power of the Lufira, which will furnish much more than the 25,000 h.p. originally estimated; in fact, sufficient to permit of the annual production of 50,000 tons of electrolytic copper.

The A.E.G.—At the recent annual meeting Herr Walter Rathenau was re-elected on the board of directors, and the board was authorised to issue new ordinary shares of up to 250,000,000 marks, the right of shareholders to subscribe being excluded. It was explained that although no definite plan existed for the purpose, the new shares were destined as exchange for participation in other undertakings which, in the opinion of the directors, might appear desirable. The dividend, at the rate of 16 per cent., was approved after suggestions had been made that the rate ought to be higher, having regard to the large amount of the open reserves, as well as of the undisclosed reserves as represented by investments and plant written down to one mark, &c. It was contended on behalf of the board that a higher dividend would only be justified if there was reason for believing that it could be maintained in the future.

Applications for British Trade-Marks.—Appended is a summary of the recent applications for British trade-marks in respect of goods and productions connected with the electrical trades and industries:—

Nox (lettering and design). No. 419,524. Class 8. Electric lamps (philosophical).—Walter Ellis and Horace Wooldridge, trading in co-partnership, 13, Infirmary Street, Leeds. October 14th, 1921.

Eddystatt. No. 418,038. Class 8. Electric and electro-magnetic apparatus and appliances.—Electric Control, Ltd., 177, Reid Street, Bridgeton, Glasgow. August 27th, 1921.

Federal (lettering and design). No. 413,294. Class 13. Electrical fuses, clamp bushings, outlet box covers, &c.—Federal Electric Co., 8,700, South State Street, Chicago, U.S.A. March 10th, 1921.

Megohmit (lettering and design). No. 418,165. Class 50. A preparation of megohmit for electrical insulating purposes.—Meirowsky & Co. Gesellschaft, 137, Kaiserstrasse Porz-am-Rhein, Germany. August 31st, 1921.

Celenese. No. 419,540. Class 50. Filaments, fibres, &c., wholly or principally from cellulose derivatives, electrical insulating materials, &c.—British Cellulose and Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London, S.W. October 14th, 1921.

Cilanese. No. 419,541. Class 50. Filaments, fibres, &c., wholly or principally from cellulose derivatives, electrical insulating materials, &c.—British Cellulose and Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London, S.W. October 14th, 1921.

Tradesmen Using the Royal Arms.—The *London Gazette* for January 3rd contains lists of tradesmen in London and elsewhere who hold warrants of appointment to Royalty.

Chinese Notes.—The China Electric Co. proposes to build the Harbin Electric Railway. A contract has been signed with an American engineering company. Its temporary offices are at Fu Kia Tien.

Specifications for power-house machinery, rails, rolling stock, and workshop equipment for the Peking Electric Tramway Co., Ltd., are now in preparation.

Preparations are in progress for the establishment of a company to undertake the construction of tramways in Hankow.

Petitions have been addressed to the Ministry of Agriculture and Commerce by a Tsinan merchant for the construction of tramways in the city. The Ministry has dispatched representatives to make investigations before official approval is granted.

The Yau Hua Electric Co., at Hsu Shih-kwan, Soochow, started business on October 1st. The company has just ordered a large plant from a Shanghai firm to be installed in Hsu Shi-kwan.

Kwang Hwa Electric Light Co., Ltd., established at Laohokow (Hupeh) with a capital of 70,000 dols., was registered at the Ministry of Agriculture and Commerce on August 18th.

The Ministries of the Interior, Agriculture and Commerce, and Communications have approved of an electric company at Peitaiho.

The Lee Hua Electric Light Co., in Tsing Kiang-pu Kiangsu, was to have been opened at the end of last year; 2,000 lights had been installed.

Li Chia-ju and others have organised the Hanyang Electric Co. and applied to the Ministry of Agriculture and Commerce and the Ministry of Communications for registration.

Industrial Agreements in Norway.—On December 27th the National Association of Employers gave notice of termination of a series of agreements and arbitrators' awards to expire on March 31st. Among the trades and industries affected are the mining industry, engineering works, the electro-technical industry, glass works, shoe factories, the building trades, the printing industry, the furniture industry, and shipping.

Price Reductions.—The Automatic Telephone Manufacturing Co., Ltd., announce a reduction of 16 per cent. in the prices of its "Xcel" electric heating and cooking appliances as from the beginning of this year.

Bank for Electrical Securities.—The Berlin Electricity Works Company, whose supply works were expropriated by the Berlin Municipal Council several years ago and which has since been merely an investment company under the continued control of the A.E.G., has now been transformed into the Bank for Electrical Securities.

Copper and Lead Prices.—Messrs. F. Smith & Co. report January 4th:—Copper (electrolytic bars), £74 15s., 10s. decrease; ditto sheets, no change; ditto wire rods, £90 15s., 10s. decrease; h.c. wire, 11¼d., 1/16d. decrease.

Messrs. James & Shakespeare report January 4th:—Copper bars (best selected), sheet and rods, no change; English pig lead, no change.

Osram Lamps in Holland.—The Osram Glow Lamp Company has been formed at Amsterdam to attend to the Dutch interests of the German glow lamp group, composed of the A.E.G., the Siemens & Halske Co., and the Osram Works Co.

British Company's Bid for Balkan Trade.—Reuter has received a report *via* New York to the effect that the Austrian Government has allowed it to become known that Messrs. Vickers-Armstrong are offering to purchase the great Woellersdorf Arsenal for conversion into works for the manufacture of locomotives for Balkan orders.

Belgian Company.—La Société des Cableries de Seneffe is the name of a new company which has lately been formed at Seneffe with a capital of 2,500,000 fr. to manufacture electric wires and cables, accumulators, &c.

Book Notices.—"*Journal* of the Institution of Electrical Engineers," Vol. LX, No. 304, December, 1921.—This issue contains the inaugural address by the president (Mr. J. S. Highfield), and the chairmen's addresses to the North-Eastern, South Midland, Western, Scottish, North-Western, and North Midland Centres, and the East Midland, Liverpool, and Sheffield Sub-Centres, also the inaugural address to the Wireless Section by the chairman (Prof. G. W. O. Howe). The issue also contains the following papers: "Design of Direct Current Armature Windings," by Mr. H .E. Dance, "Properties and Characteristics of Insulating Materials," by Mr. R. T. Fleming," "Telephonic Transmission through Submarine Cables," by Mr. A. Rosen, and "Radio-Telegraphic Transmitters," by Mr. A. G. Warren.

"Industrial Welfare," Vol IV, No. 1, January, 1922. London: Industrial Welfare Society. Price 9d.—The first number of the fourth volume of the "Journal of Industrial Welfare" appears under a simplified title. Among the interesting articles to be found in this issue is one upon "An

Industrial Parliament," by the Rt. Hon. Arthur Henderson, M.P.; Mr. Albert Barratt, J.P., writes on "Making Co-partnership a Success.'

Whose Land? or Some Account of the Original Inhabitants of London. Pp. 14+ii; 14 illustrations. London: Traffic Advertising Agent of the Underground Electric Railways and the L.G.O.C., Ltd.—For many of London's children the country motor 'bus is the key to nature's fairyland; to a countryside of whose delight many of them might see and know but little. This excellent little booklet of verse by Miss Jessie Pope, with its fairyland drawings by Miss Jessie King, should make a strong appeal to the younger generation of Londoners. It is being circulated to the elementary schools, and comes aptly at a time when the L.G.O.C. has given effect to a popular innovation in the shape of cheap fares for children on all its omnibus routes.

Electric Lighting in Factories and Workshops, by Leon Gaster and J. S. Dow. Pp. 37; figs. 19. London: Sir Isaac Pitman & Sons, Ltd. Price 6d. net.—There has recently appeared a most admirable pamphlet* setting forth the advantages of a satisfactory lighting system for industrial purposes, but its style is very different from this little booklet, which deals with the subject in a conversational manner. Other than certain statistics of American origin data are well chosen and forceful. The requirements of good lighting are concisely summarised and the advantages of well selected reflectors briefly stated; it is to be regretted that the illustrations of shades and reflectors on page 15 are not more nearly to the same scale. It is noteworthy that the authors recommend the calling in of a trained illuminating engineer, though they give brief particulars which should enable an ordinary electrician to carry out a simple installation. Emphasis is laid upon the importance of maintaining equipment by periodic inspection and cleaning. As examples, an engineering shop and office, a clothing factory, and a boot factory, are dealt with; there are, of course, points which might be questioned, just as doctors may argue regarding diagnosis and treatment, but on the whole we are impressed with the clarity with which the various ideas are adumbrated. We do not doubt but that the booklet will serve a useful purpose.

"The Swedish Year Book for 1921" (first year of issue). London: Williams & Norgate. Price 7s. 6d. net.

Circular No. 38 of the U.S. Bureau of Standards, "The Testing of Rubber Goods" (127 pp.). Washington: Government Printing Office. Price 20 cents. This describes in detail the Bureau's methods of testing such articles as tires, hose, and moulded rubber.

"The M. & C. Apprentices' Magazine," Vol V, No. 20. Price 4d.—The organ of Messrs. Mavor & Coulson's apprentices is, as usual, full of interesting matter, both technical and general.

A new edition of their catalogue of scientific and technical books has been issued by SIR ISAAC PITMAN & SONS, LTD., Parker Street, Kingsway, W.C.2. The subjects dealt with range from the production of coffee to anthropometry, and the engineering and electrical sections contain numerous works of value. The price and other particulars of each book are given, with a brief description of its scope. The indexes catalogue subjects and authors' names.

"Electrical Installation Rules and Tables for Rapid Reference," by W. S. Ibbetson. London: E. & F. N. Spon, Ltd. Price 1s. 6d.

"Textile Recorder Year Book for 1922," by F. Nasmith. Manchester: John Heywood, Ltd. Price 7s. 6d. net.

LIGHTING AND POWER NOTES.

Aberayron.—SPECIAL ORDER.—The Urban Council is making a grant of £100 towards the cost of obtaining a Special Order to enable the Electric Light Co. to provide a supply of electricity for the town. The company has undertaken to apply for the Order forthwith, and to proceed with the scheme without further delay.

Accrington.—YEAR'S WORKING.—The accounts of the electricity undertaking for the year ended March 31st last show a gross income of £76,776, as compared with £54,084 in the previous year. Working expenses amounted to £71,967, as against £43,369, leaving a gross profit of £4,809 (£10,715). The net result was a deficit of £9,131, as against £989 in 1919-20.

PROPOSED LINKING UP.—There is a certain amount of objection in Accrington to linking up with Blackburn, as it is pointed out that Blackburn's new station was erected at a time when materials and labour were at high-water mark, averaging £40 per kW of plant installed, compared with £16 per kW for the extensions proposed at Accrington. Including the cost of cable, transformers, and switchboard, the cost of connecting the two stations is roughly estimated to be £36,000, and, according to the latest decision of the Commissioners, this will have to be met jointly by the two authorities.

*ELECTRICAL REVIEW, September 23rd, 1921; page 422.

LOAN.—The Corporation has decided to proceed with its application for sanction to borrow £100,000 for the purpose of extensions to the electricity station, in accordance with the understanding arrived at with the Electricity Commissioners recently. The revised figures show a decrease of £30,000 from the original estimate.

Australia.—SYDNEY.—The Municipal Council has received a letter granting it authority to borrow, by the sale of debentures, a sum of £2,000,000 bearing interest at a rate not exceeding 6½ per cent. per annum for capital expenditure in connection with the electricity supply undertaking, in such sums as may be required from time to time for the period ending December 31st, 1923.

ORANGE, N.S.W.—The Municipal Council is taking steps to raise a loan of £39,000 to finance an electric lighting scheme to serve the town. The plant proposed to be installed includes two boilers, with auxiliary equipment, and two 200-kW generating sets

Banff.—JOINT ELECTRICITY SCHEME.—Mr. Bell, of Aberdeen, in a report to the Town Council, approves of a joint electricity scheme between Banff and Macduff. For a separate scheme he put the cost for Banff at £14,000 and for Macduff at £13,500; the cost to the consumer would also be greater. A scheme is to be prepared.

Bedford.—REVISED CHARGES.—The Town Council has reduced the charge for electricity for heating from 2d. to 1½d. per unit. In the case of combined lighting and heating, or cooking, no charge will be made for laying services, subject to the consumer's agreeing to pay the Corporation in advance, a minimum revenue for the first year calculated at the rate of £5 per 1,000 watts installed for heating, with a minimum payment of £5. In the case of a consumer, whose premises are already equipped with lighting, requiring a heating service, such a service will be carried out free of charge, subject to the payment of a minimum of £5 per annum.

Boston.—ELECTRICITY SCHEME.—The Boston Deep Sea Fishing Co., Ltd., has offered to supply the town and district with electricity, and the Town Council has intimated that it would welcome such a scheme. At present a provisional Order for supplying the town is held by the National Electric Construction Co.

Bromley.—CHANGE OF SYSTEM.—The Bromley Electric Light and Power Co. has formally notified the Town Council of its intention to change the system of supply from 210 and 420 V d.c. to a.c. at 50 cycles and the same pressures. The a.c. system is being adopted on account of the difficulty experienced in transmission to outlying parts of the company's area. A new high-pressure main will be laid and a number of transformer stations erected.

Canada.—OPENING OF CHIPPAWA CANAL.—The Chippawa Power Canal, which was commenced in 1917, was to be put into commission on December 28th. This canal is 12¾ miles in length and was cut to divert the waters of the Upper Niagara into the Welland River. The development was described at some length in our issue of October 8th, 1920 (p. 477). The ultimate capacity will be between five and six hundred thousand h.p.

Cannock.—LOAN.—The Urban District Council is applying to the Electricity Commissioners for sanction to a loan of £36,753 for electricity purposes.

Cheshunt.—COMPANY'S APPLICATION.—The North Metropolitan Electric Power Supply Co. has asked the Urban Council for its consent to the company supplying electricity to the town.

Continental.—NORWAY.—The Swedish General Electric Co., Ltd., of Västeras, Sweden (Allmänna Svenska Elektriska Aktiebolaget), has recently completed a large generator, said to be larger than any machine of the kind hitherto produced in Europe. The generator is intended for the Norwegian Government power station, "Glomfiord," situated at the lower end of the Glom Fiord, about nineteen miles north of the Arctic Circle. The generator will produce 24,000 kW, at 300 revolutions, 25 cycles and 15,000V. Its length is 7.4 metres, measured from the turbine flange to the outside edge of the feeder; the width is 8.4 metres. Including all accessories, the weight is 260 tons. Railway and steamer freights alone approached the sum of £2,000, and sea insurance nearly £500. Loading into the steamer occupied nearly a week.

FRANCE.—Application has been made by the Société de Distribution d'Electricité for a concession to distribute electricity in the departments of the Orne, Eure, Eure-et-Loire, Mayenne, Manche, and Maine-et-Loire. The extensive network will be divided into three main portions, each served by a separate steam generating station.

Combinations of groups of rural villages to supply themselves with electricity, with the help of the State subsidy to the extent of one-third of the estimated cost, provided by the Decree of October 8th, 1917, are growing in favour in France. One of the latest of such combinations is that of Sutrin in the Département de l'Ain. It comprises twelve villages, and the scheme is reckoned to cost some 900,000 fr. Power is obtained by agreement from existing companies, and

is sold at special rates of 1.50 fr. per kWh for lighting and 0.60 fr. for motive power.

The continuous drought which prevailed last year, lasting far into December, seriously affected the hydro-electric industry in France. The Alpine districts were especially hard hit; the volume of the waters of the Rhône and the Danube fell off to a great extent. One of the results of the drought was increased expenses, hydro-electric companies being forced to resort to steam generation. In the Alpine districts the Société Force et Lumière, the Electricité de la Loire, and the Compagnie du Centre had to reduce their supplies, as had also the Union Electrique de l'Ain. The Société du Gaz of Lyons registered a daily deficit of more than 70,000 kWh, which involved a supplementary consumption of coal of about 100 tons a day. The works of the Port de Fier, in the Isère Department, started a little over a year ago with a theoretical flow of 60 cubic metres a second, but practically 40 cubic metres; it was reduced to 21 cubic metres, and had to resort to its steam plant. The drought reduced by one-third the production of the Société Force et Lumière, and an extra expenditure of 600,000 fr. was incurred. The Jonage Company had also to resort to steam generation to the extent of 50 per cent. of its output. These facts provide much food for thought, though their weight has been lessened by the general industrial stagnation. What has happened, however, shows that it is necessary to co-ordinate the control of France's water resources and to standardise both works and transmission lines. The Société du Sud-Est has already begun to make modifications in this direction.—*L'Elettricista.*

Italy.—The Rome correspondent of the *Morning Post* states that the Roman Municipal Council has approved the contract with the Tivoli Municipality for the utilisation of the Tivoli Waterfalls for generating electricity. The scheme has been criticised on account of the probable cost, one authority estimating this at 100,000,000 lire.

Belgium.—The Technical Section of the authority for Western Flanders has drawn up a scheme for the establishment of stations for the supply of electrical energy for lighting and power purposes throughout the province. The work is estimated to cost 9,900,000 fr., and arrangements are being made to negotiate a first loan of 5,000,000 fr. in connection with the undertaking.

In a recent speech the Governor of the Province of Antwerp stated that the preparation of a scheme and plans for supplying every commune of the province with light and power had been entrusted to a group of experts, and that the intention was to realise the scheme as speedily as possible.

The Société d'Electricité du Brabant now holds the concession for the supply of electrical energy for lighting and power purposes to twenty-one small towns and villages, the total population supplied being 110,000. In order to meet the increasing demand for power a new 2,000-kW generating set is being installed at the power station, and is expected to be ready for operation shortly.

Germany.—Up to the present, says the *Berliner Tageblatt*, the great Golpa power works at Bitterfeld, from which Berlin receives part of its electricity, has been the largest steam power works in Germany. This position, however, will shortly belong to the Goldenberg plant of the Rheinisch-Westfälisches Electrizitätswerk. The Goldenberg power works has, at present, a capacity of about 200,000 kW. Half of this amount is provided by two A.E.G. steam turbine sets of 50,000 kW capacity each. The directors of the R.W.E. have now decided to increase the Goldenberg-Zentrale by two more units with a capacity of 50,000 kW each. These machines have been ordered from the A.E.G., and when the new plant is in operation the Goldenberg works will have a capacity of about 300,000 kW.—*Reuter's Trade Service* (Berlin).

Connah's Quay.—Electricity Supply.—The Council has taken into consideration preparations for a distribution plant and other work required to be performed consequent upon the North Wales Power Company being constituted authorised suppliers in the district. The question of an application for a loan in respect of this work is also to be discussed.

Croydon. — Supply Contract.—The Town Council has arranged to supply electricity to works in Morland Road at 2d. per unit for 100,000 units a year, and 1½d. beyond, with a minimum annual payment of £2,000.

Dundee.—New Cables.—The purchase of cables at a cost of £1,988 has been approved by the Corporation Electricity Committee.

East Lothian.—Electricity Supply.—The County Council proposes to engage an electrical engineer to report on the most feasible and economical scheme for the supply of electricity to the county. Negotiations are to be opened with the burghs and colliery owners and other probable consumers. There is a proposal that Edinburgh Corporation should give a bulk supply from the new power station at Portobello, leaving the County Council and other local authorities to arrange for distribution.

Edinburgh.—Suggested Exhibition.—The Electricity Committee recently received a deputation from the Electrical Contractors' Association urging the arranging of an Electrical Exhibition in Edinburgh prior to the opening of the new power station at Portobello. The subject was remitted to a sub-committee.

Electricity District.—West of Scotland.—The Electricity Commissioners have provisionally determined that the undermentioned area shall be constituted a separate electricity district for the purposes of the Electricity (Supply) Act, 1919, that is to say:—

The County of the City of Glasgow; the County of Renfrew.

So much of the County of Ayr as is included in the Royal Burghs of Ayr and Irvine; the burghs of Ardrossan, Darvel, Galston, Kilmarnock, Kilwinning, Largs, Newmilns and Greenholm, Prestwick, Saltcoats, Stewarton, and Troon. The parishes of Ardrossan, Ayr, Beith, Coylton, Craigie, Dalry, Dalrymple, Dreghorn, Dundonald, Dunlop, Fenwick, Galston, Irvine, Kilbirnie, Kilmarnock, Kilmaurs, Kilwinning, Largs, Loudoun, Mauchline, Monkton and Prestwick, Ochiltree, Riccarton, Stair, Stevenston, Stewarton, Symington, Tarbolton, and West Kilbride.

So much of the County of Dumbarton as is included in the Royal Burgh of Dumbarton; the burghs of Clydebank, Kirkintilloch, and Milngavie; the parishes of Bonhill, Cardross, Dumbarton, Old Kilpatrick, New Kilpatrick, and Kirkintilloch.

So much of the County of Lanark as is included in the Royal Burghs of Lanark, Renfrew, and Rutherglen; the burghs of Airdrie, Coatbridge, Hamilton, and Motherwell and Wishaw; the parishes of Blantyre, Bothwell, Cadder, Cambuslang, Cambusnethan, Carluke, Carmunnock, Dalserf, Dalziel, East Kilbride, Glasgow, Glasford, Hamilton, Lanark, Old Monkland, New Monkland, Rutherglen, Shotts, and Stonehouse.

So much of the County of Stirling as is included in the parishes of Baldernock, Campsie, and Strathblane.

Objections or representations may be made on account of the inclusion of any area in, or the exclusion of any area from, the district in writing to the Electricity Commission not later than December 30th, 1922. It being apparent to the Electricity Commissioners that the existing organisation for the supply of electricity in the district should be improved, they intend to hold a local inquiry into the matter, and any body directly concerned with the production or use of electrical energy within the district may before December 30th, 1922, submit in writing a scheme for effecting such improvement in organisation, including the formation of a Joint Electricity Authority for the district. Notice will be given of the date of the proposed inquiry.

Glasgow.—New Houses.—Both gas and electricity are to be supplied to the houses in the Corporation building schemes, the Housing Department paying £20,000 to the Gas Department and £10,000 to the Electricity Department towards the cost of installing the necessary mains. There was a suggestion that some of the houses should form an "all gas" area, while others should form an "all electric" area, but these proposals were withdrawn.

Harrogate.—Year's Working.—The accounts of the Corporation's electricity undertaking (Engineer: Mr. G. Wilkinson) for the year ended March 25th, 1921, show a total revenue of £39,169, as compared with £28,372 in the previous year. Working expenses totalled £26,578, as against £18,457, leaving a gross profit of £12,591 (£9,915). After payment of capital and other charges a net profit of £3,949 remained, this being utilised to defray capital expenditure. In 1919-20 a sum of £1,195 was expended under this head. The total number of units sold was 2,358,956, and the maximum demand 1,596 kW.

Hawkshead (Lake District). — Proposed Electricity Scheme.—As a result of a town's meeting to consider the prospects of a local electric light and power scheme for the township, a committee has been formed to go into details with a view to the promotion of a company or other form of guarantee for the capital outlay involved. The estimated capital outlay for a scheme of supply within a half-mile radius is £750, and technical details were supplied by Mr. Wilkinson, of Arnside.

Ireland.—Activities of a Belgian Company.—A Belgian electro-technical company, having for title "The Irish Overseas Direct Trading and Electric Lighting Association," has just obtained a concession for the supply of electric lighting to Blackrock (co. Dublin). Application by the same company for a concession to supply lighting and motive energy to the town of Dun Laoghaire (Kingstown) is being considered. The company proposes to sell electricity to the public at 8d. per kWh for lighting, 2½d. for motive power, and 4d. for heating purposes.—*Eclairage et Force Motrice.*

Keighley.—Loan.—The Electricity Committee recommends application to the Electricity Commissioners for sanction to borrow £5,000 for the purpose of installing the necessary feeders and distributors in the area covered by the Electric Lighting (Extension) Order, 1915. The area includes the urban districts of Oxenhope and Oakworth. Financial assistance from the Unemployment Grants Committee is being sought.

Kilmarnock.—Extensions.—The Ayr County Council has notified the Corporation that its objection to the recent electricity extension Order will not hold if the Corporation will agree to lay mains in the southern part of the extended area if and when the County Council requests it to do so. The Kilmarnock Corporation has agreed to this, reserving, however, the right to appeal to the Electricity Commission for a decision in cases where such mains are likely to prove unremunerative.

Morecambe.—LOAN.—The Finance Committee has approved the Electricity Committee's recommendation of an extraordinary expenditure of £5,000 for the better lighting of the sea front from Battery to Bare, and advises application to the Electricity Commissioners for power to borrow this sum.

Northampton. — PRICE REDUCTION—CORRECTION. — The Northampton Electric Light & Power Co., Ltd., informs us that the reduction of 1d. per unit is not in the charge for lighting energy (as stated in our issue of December 23rd), but for power.

Oxted.—ELECTRICITY SUPPLY.—At a meeting of the Council a letter was read from the Sevenoaks and District Electricity Co., Ltd., stating that the Electricity Commissioners had decided not to revoke the company's powers of supply in Oxted and Limpsfield. If a grant in aid of the work could be obtained from the State a cable would be laid at once. The Council resolved to support the company's application.

Perth.—STATE ASSISTANCE.—The Unemployment Grants Committee has agreed to refund 60 per cent. of the money paid in wages to men engaged upon the renewal of a number of mains.

Preston.—EXTENSIONS APPROVED.—The Council has received the sanction of the Electricity Commission to the extension of the generating station at Deepdale.

Rugeley.—ELECTRICITY SUPPLY REQUIRED.—The Urban District Council has asked the Wolverhampton Corporation whether that body is prepared to supply electricity for lighting and power to the district.

Southwick.—COMPANY'S APPLICATION.—The Shoreham and District Electric Lighting and Power Co., Ltd., gives notice of its intention to apply to the Electricity Commissioners for an Order permitting it to supply electricity to places within the Urban District of Southwick.

Truro.—BREAKDOWN OF NEGOTIATIONS.—Asserting that the high prices asked by the Cornwall Electric Power Co. would impose a burden upon the ratepayers, the City Council has broken off negotiations with the company for a supply of electricity to the town. It is stated that the Council will now proceed with a scheme of its own involving the erection of a station at Newham.

Warrington.—LOAN.—The Electricity Committee is applying to the Electricity Commissioners for sanction to the borrowing of £4,440 in respect of sub-station gear necessary for affording a supply to the outlying districts.

PRICE REDUCTION.—At the January meeting of the Town Council the Electricity Committee will present a resolution for the withdrawal, as from December 31st, of the last three increases in the price of electricity. The increases which it is proposed to withdraw were made in 1920, and total 30 per cent. on the cost of energy for lighting and traction and 60 per cent. on the cost of power based on pre-war prices.

West Bromwich.—PRICE REDUCTION.—The Town Council has decided to lower the charge for electricity for power by 12½ per cent. from the December reading of the meters, and alternatively to offer power consumers electricity at the rate of £9 per kW demanded and 1d. per unit consumed. The lighting charges remain at 100 per cent. above pre-war charges.

Wexford.—CONTRACTS ACCEPTED. — The Corporation has accepted the tender of Mr. J. J. Stafford to supply electricity for public lighting at 6d. per unit, and a tender of Messrs. Ferguson & Bruty, Dublin, for £2,574, for the erection of poles and mains.

Worcester.—EXTENSIONS APPROVED.—The Electricity Committee reports the receipt of a letter from the Electricity Commissioners consenting to the extension of the generating station by the installation of a 3,000-kW set, three boilers and auxiliary plant, and by the construction of the necessary buildings. No material departure from the engineering proposals in connection with the extension is to be made without first submitting details to the Commissioners and obtaining their sanction.

TRAMWAY AND RAILWAY NOTES.

Accrington.—YEAR'S WORKING.—The revenue of the Corporation tramway undertaking for the year ended March 31st last was £62,849, as compared with £50,153 in 1919-20. Expenditure amounted to £53,426 leaving a gross profit of £9,423. The net result was a loss of £2,008, comparing unfavourably with a deficit of £295 in the preceding year.

Australia.—PROPOSED RAILWAY ELECTRIFICATION.—The South Australian Minister for Railways recently said that he had considered the question of converting to electric traction the line running from Adelaide to Murray Bridge. He thought that money would be well spent in obtaining a report regarding the cost of such a project.—*Reuter's Trade Service* (Melbourne).

MELBOURNE.—The Legislative Assembly has passed a Bill authorising the inauguration of electric railless car systems in the outer suburbs of Melbourne.—*Modern Transport.*

ADELAIDE.—The Melbourne *Argus* recently reported that large additions to the Adelaide Tramway Trust's plant were being made, and that it was expected that the new equipment would be in commission by the end of last year. The additions consisted of a 6,000-kW Curtis turbo-alternating set, manufactured by the British Thomson-Houston Co., and a condenser supplied by G. W. Kelly & Lewis, and made at the Melbourne works.—*Reuter's Trade Service* (Melbourne).

Birmingham.—FARE REDUCTION NOT APPROVED.—The question of the possibility of a revision of the tram fares (the minimum fare being 1½d.) was considered by the Tramway Committee on January 2nd. It was stated that owing to the high administrative costs it could not, at present, recommend any reduction.

Burnley.—NEW CARS.—Three of the five new tramcars ordered for the Manchester-road system, are being delivered, and the remainder will make their appearance shortly. The cost of each car will be almost £4,000, compared with about £1,000 before the war.

Canada.—ONTARIO.—Ontario has decided to purchase, at a cost of £666,000, the electric railway running from Toronto to Guelph which was built by the Canadian Northern Railway, and is now part of the Canadian Government system. The electors have also agreed to guarantee the bonds of an electric railway running eastward from Toronto 30 miles to Bowmanville. The municipalities of the Niagara Peninsula are to acquire the Niagara, St. Catharines and Toronto Electric Railway, to be operated by the Hydro-Electric Commission of the Province.—*The Times.*

Edinburgh.—TRAMWAY ELECTRIFICATION.—The Tramways Committee has decided in favour of the electrification of the tramways in Princes Street, and the use of central poles to carry the overhead wires.

London.—JAPANESE INSPECT "UNDERGROUND" SYSTEM.—On December 29th the members of the Japanese delegation of business men were invited by the Underground Railways Co. to inspect London's traffic system. The party visited the Lot's Road generating station, the Traffic Controller's office, the lifts, moving stairways, &c., and expressed their interest and amazement. At a subsequent luncheon one of the members of the delegation compared the transport systems of Tokio and London, and referred to the formation of a company to construct underground railways. He said this company was still in its initial stages, and nothing had been done so far as construction was concerned.

Preston.—SUNDAY CARS.—At a meeting of the Town Council on December 29th, a re-consideration of the question of running Sunday cars, which had resulted in a loss of from £10 to £14 per week, was advocated. It was stated, however, that public convenience must be considered, and a motion to refer the matter back was defeated.

Scarborough.—CARS CONTINUE RUNNING.—Before the end of last year, when the electric tramways should have ceased running according to a decision after conferences between the company, the Corporation and the Ministry of Transport, further consultations were held in London upon three offers for the undertaking. The company has accepted the offer of a combination of London and Yorkshire tramway interests, with the probable addition of some local people. Mr. H. Seaton, of the Scarborough Yellow Motor 'Bus and Motor Coach Service, has accepted an invitation to be managing director of the new concern—in which the public may be invited to take shares—and, on receipt of instructions, Mr. Moinet, the local tramway manager, continued the service uninterruptedly. The new undertaking, whose control is subject only to the approval of a meeting of shareholders of the tramway company, will run the cars and the Yellow Motor 'Buses in conjunction, developing the service on routes not yet covered by the tramways.

Taunton.—REVIVAL OF SYSTEM SUGGESTED.—At a recent meeting of the Town Council a number of members advocated the revival of the tramway system owing to the alleged inadequacy of the 'bus services. It will be recollected that the Taunton Electric Tramways Co. was forced to close down in May last owing to its inability to pay the price demanded by the Council for electricity. A recent order of the Ministry of Transport cancelled the two orders held by the company. At the meeting mentioned above the Mayor pointed out that to take over and work the system of the company would necessitate the obtaining of another order. In the meantime, however, the Council had decided to allow the permanent way to remain in position.

Wallasey.—PROPOSED FARE REVISION.—The Tramways Committee recommends the re-introduction of penny stages, in view of the serious decrease in traffic since the stages were shortened and the fares were increased. Other proposals are: a discount of twopence in the shilling on prepaid books of tickets instead of the present books of thirteen tickets at the price of a dozen; workmen's tickets available up to 7.30 a.m. instead of 7 a.m.; and the age for children's tickets to be fourteen years instead of twelve.

TELEGRAPH AND TELEPHONE NOTES.

Australia. — WIRELESS OPERATORS. — Mr. Atlee Hunt, Federal Public Service Arbitrator, at the Commonwealth Bank Building at Sydney, in October, presided as arbitrator in the matter of a claim for improved conditions made by the Radio Telegraphists' Institute of Australasia against the Public Service Commission and the Postmaster-General.

The institute claimed that the minimum salaries per annum to wireless operators should be: Administrative officers, Class D (professional division) from £567 in the first year to £693 in the sixth year; inspectors and stationmasters in charge of continuous stations, Class E (professional division), from £443 in the first year to £569 in the sixth; senior telegraphists, class 4, and station masters in charge of non-continuous stations, Class F (professional division), £380; telegraphists, class 4, grade 2, £355; telegraphists, class 4, grade 1, £280 in the first year to £340 in the fifth year; mechanics (general division), £304; senior mechanics, £334, and foremen mechanics £364; radio engineers, class E (professional division), £567 in the first year to £642 in the fourth year. The hours claimed were 6½ hours unbroken, and for broken shifts 39 hours a week; and that wireless telegraphists should not be called upon to perform any duty for a longer period than nine hours, except in urgent cases, when double overtime should be paid.

The service was established in 1911 on a clerical basis, but suitable men could not be obtained in the public service, and a reorganisation was made on a professional basis. When the war broke out the men were transferred from the Postmaster-General's Department to the Department of the Navy, under which they remained until last year, and it was contended that they had suffered a reduction in status during that period, which had materially affected their welfare with regard to the positions they should now be occupying and the salaries they should be drawing. They had no say in the transfer, and being regarded as enlisted persons, could not initiate any claim during the war.

The Telegraph Service.—FOREIGN PRESS TELEGRAMS.—The Postmaster-General announces that on and from January 1st, Press telegrams at reduced rates for Austria, Lithuania, Poland, and Czecho-Slovakia will be accepted at post offices on the usual conditions between 9 a.m. and 12 noon, as well as between the normal hours of 6 p.m. and 9 a.m. Press telegrams for Esthonia and Latvia will be accepted between 9 and 11 a.m. as well as between the normal hours of 6 p.m. and 9 a.m.

MONEY ORDER SERVICE.—The telegraph money-order service with British Oversea Dominions, Dependencies, &c., was extended on January 2nd to Kenya and Uganda. A special feature of the service is that the telegrams of advice may be sent at the deferred rate, which reduces the telegraph charges by one-half. The full-rate service is available for cases of special urgency.

France.—WIRELESS TELEPHONY.—The French Under-Secretary for Post, Telegraphs, and Telephones announces that he is prepared to receive applications for the installation of the wireless telephone on private premises. Over a distance of 30 miles the cost of a complete station will be about 17,000 fr. (approximately £340).—*The Times.*

Germany.—NEW TELEGRAPH SERVICE.—A new service for rapid transmission of telegrams is contemplated for all Germany. It is to be put on trial between Berlin and Hamburg in this month, says the *Manchester Guardian.*

"Lightning wireless" stations will be established in both towns. A telegraph message can be telephoned to one of the stations. It will be transmitted by wireless to the other, and from there it will be telephoned to the person to whom it is addressed. The charge per word is to be 50 marks, with a minimum charge of 500 marks for the entire telegram. It is assumed that once the service is in working order it will be possible to receive a telegram a few minutes after it has been sent.

Holland.—CABLE RIGHTS ON YAP.—The heads of the delegations of the five big powers and the Netherlands have agreed to an arrangement by which Holland, as well as the United States and Japan, will be given cable rights on the Island of Yap.—*Reuter's Trade Service* (Washington).

The Telephone Service.—NEW WALLASEY EXCHANGE.—On December 31st a new telephone exchange was opened at Wallasey to replace with up-to-date apparatus the existing exchange. The new exchange serves the same area as did the old one.

TELEPHONE TO BASS ROCK.—Telephonic communication has been established between the Bass Rock, in the Firth of Forth, and North Berwick, a distance of four miles. A cable was laid by the Government during the war, when the islet was in use by the Admiralty, but was later withdrawn. It has just been replaced, says the *Observer*, and is expected to prove of valuable service, especially in cases of shipping mishaps, rendering necessary the calling out of the lifeboat on the mainland.

CONTRACTS OPEN AND CLOSED.

(The date given in parenthesis at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—MELBOURNE.—February 20th. City Council. Electricity Department. One rotary converter with transformer, &c.; 6,600 V switchgear. (City Electrical Engineer.)

SYDNEY.—April 24th. Electricity Department. Two 2,000-kW rotary converters, and one 10,000 to 12,000-kW turbo-alternator.*

Aylesbury.—Electricity Department. One 300-kW converter, with e.h.p. and l.p. switchgear. (See this issue.)

Belgium.—January 17th. Municipal authorities of Schaerbeek. Supply and installation of a system of internal telephone communication in the various offices of the municipal building. Specification from the Caisse Communale, Schaerbeek, Brussels.

January 31st. For the establishment of a central electricity generating station and a system of high and low-pressure distribution mains, for the Intercommunale d'Electricité de la Province de Namur. Particulars from M. Desiré Martin, Echevin, Rouge (Namur).

Chile.—February 4th. State Railways. Twelve windmills, complete; one electric compressor; one air-storage drum and d.c. motor; 1,300 metal-filament lamps for lighting locomotives; 38 wall telephones.*

East Ham.—January 12th. Electricity Department. One 1,500-kW converter, either rotary or motor type; e.h.p. and l.p. switchgear and connectors. (December 23rd.)

Edinburgh.—January 19th. Corporation. Electric lighting installation at the Public Wash-house, Causewayside. City engineer.

France.—January 15th. French Post and Telegraph authorities, Paris (Rue de Rennes). 300 vacuum tube lamps of 1-kW capacity for use in connection with the wireless telegraphy service. Particulars from 5, Rue Froidevaux, Paris.

India.—MADRAS.—February 20th. Corporation. Various paper-insulated, &c., cables already detailed here. Specifications and forms of tender (4s. per set) from the Publisher, ELECTRICAL REVIEW. (December 31st.)

Leeds.—January 12th. Electricity Department. Single-phase wattmeters for 12 months (minimum 2,000). (December 31st.)

Maldens and Coombe.—January 10th. Urban District Council. Two 10-b.h.p. horizontal electric motors, starting gear, &c. Also electric lighting installation at Blakes Lane pumping station. Mr. R. H. Jeffes, engineer and surveyor, Municipal Offices, New Malden.

Newcastle-under-Lyme.—January 17th. Electricity Supply Department. 600 yd. .1, .035, .1 l.p. lead-covered steel armoured distributor cable. (See this issue.)

New Zealand. — WELLINGTON. — February 24th. Public Works Department. Three 11,000-V reactances complete, for the Lake Coleridge electric power scheme.*

South Africa.—PRETORIA.—February 1st. Public Works Department. Conduit and conduit fittings. Electrical Engineer, Public Works Department, Pretoria.*

PORT ELIZABETH.—January 31st. Municipal Council. Tenders for electrical plant.*

Spain.—MADRID.—Direction of Posts and Telegraph.—Supply of Hughes apparatus to the value of 350,000 pesetas.—*Reuter's Trade Service* (Madrid).

*A copy of the plan, specifications, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

CLOSED.

Bedford.—Town Council. Accepted:—

One 1,500-kW turbo-alternator, with circulating pumps, &c. (£17,976).—C. A. Parsons & Co., Ltd.

Belgium.—Seven firms submitted tenders to the Belgian military authorities in Brussels for the supply of seven electric motors for the military hospital at Tournai, the lowest being that of W. Wilford, of Brussels, who quoted 4,800 or 6,700 fr.

Mansfield.—The Board of Guardians has appointed the Mansfield Engineering Co. as electricians for the ensuing six months.

New Zealand.—The Government has accepted tenders from British firms for the installation of a £100,000 hydro-electric plant for a system which is to supply Wellington and district. Further tenders are still under consideration, says the Prime Minister (Mr. Massey). American and Swedish firms competed.

Stirling.—Town Council has appointed Henderson Bros. as electricians for the ensuing year.

Warrington.—Education Committee. Accepted:—

Cables.—British Insulated & Helsby Cables, Ltd.
Sub-station switchgear.—British Thomson-Houston Co., Ltd.
A.c. and d.c. motors.—S. G. Leach & Co.
Transformers.—Fuller Electrical & Manufacturing Co., Ltd.

Salford.—Tramways Committee. Car accessories for three months to March 31st, 1922. Accepted :—

Cable and lamps.—Power & Lighting Supplies Co., Ltd.
Cable connectors, &c.—L. Andrew & Co.
Armature and field coils.—Barratt & Thornton.
Insulating varnish.—Griffiths, Bros. & Co. (London), Ltd.
Lamps.—British Insulated & Helsby Cables, Ltd.
Carbon brushes.—J. Eades.
Field coils and commutator segments.—Metropolitan-Vickers Electrical Co., Ltd.
Brake blocks.—National Railway and Tramway Appliances Co., Ltd.
Trolley head slippers.—British Insulated & Helsby Cables, Ltd.
Trolley heads.—G. W. Alsop.
Gears and pinions.—British Hele-Shaw Patent Clutch Co., Ltd.

Electricity Committee. Accepted :—

Safety valves for superheaters.—J. Musgrave & Son.
Set of fire bars sliding bottoms for front and rear end of stokers.—Underfeed Stoker Co., Ltd.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Christmas Lectures on "Electric Waves and Wireless Telephony," by Prof. J. A. Fleming, F.R.S., at Albemarle Street, Piccadilly, W. At 3 p.m. Saturday, January 7th, "Electric Waves"; Tuesday, January 10th, "Wireless Telephony."

Model Engineer Exhibition.—Saturday, January 7th to January 14th. At the Royal Horticultural Hall, London, S.W. Exhibition of small power engineering models, tools, scientific apparatus, wireless apparatus, &c. From 12 noon to 10 p.m. daily.

Institution of Electrical Engineers.—Informal meeting. Monday, January 9th. At the Institution, Victoria Embankment, S.W. At 7 p.m. Discussion on "Co operative Advertising in Relation to the Electrical Industry," to be opened by Mr. J. W. Beauchamp.

Thursday, January 12th. At the Institution, Victoria Embankment. At 6 p.m. Exhibition of the following kinematograph films :—"Investigations and Tests on High-tension Switchgear," by Mr. P. Torchio, with explanatory notes by Dr. C. C. Garrard. "Telephone Inventors of To-day" and "Electricity in the Home," exhibited by Mr. F. Gill.

(North-Eastern Centre).—Monday, January 9th. At Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Paper on "Induction Type Synchronous Motors," by Mr. L. H. A. Carr.

(Scottish Centre).—Tuesday, January 10th. At the North British Station Hotel, Edinburgh. At 7 p.m. Paper on "Induction Type Synchronous Motors," by Mr. L. H. A. Carr.

(North-Western Centre).—Tuesday, January 10th. At the Engineers' Club, Manchester. At 7 p.m. Paper on "Telephone Line Work in the U.S.A.," by Mr. E. S. Byng.

(South-Midland Centre).—Wednesday, January 11th. At the University, Birmingham. At 7 p.m. Paper on "The Cyc-Arc Process of Automatic Electric Welding," by Mr. L. J. Steele and Mr. H. Martin.

(Tees-Side Sub-Centre).—Wednesday, January 11th. At Middlesbrough. Paper on "Induction Type Synchronous Motors," by Mr. L. H. A. Carr.

National Association of Supervising Electricians.—Tuesday, January 10th. At St. Bride's Institute, Bride Lane, E.C. At 6.45 p.m. Lecture on "A Talk Round the Thermionic Valve," by Major T. Vincent Smith.

Roentgen Society.—Tuesday, January 10th. At the Institution of Electrical Engineers, Victoria Embankment, W.C.2. At 8.15 p.m. Ordinary meeting.

Institution of Civil Engineers.—Tuesday, January 10th. At the Institution, Great George Street, S.W. At 6 p.m. Papers on "Control of Trains in Relation to Increased Weight and Speed Combined with Reduced Headway," by Mr. A. W. Rendell, and "Trials in Connection with the Application of the Vacuum-Brake for Long Freight Trains," by Sir H. Fowler and Mr. H. N. Gresley.

Students' Meeting. Wednesday, January 11th. At the Institution, Great George Street, S.W. At 6 p.m. Lecture on "The Economic Aspects of Various Methods of Power Transmission," by Mr. E. W. Monkhouse.

Association of Engineers-in-Charge.—Wednesday, January 11th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Paper on "Machinery for the Production and Refining of Edible Oils for Margarine," by Mr. B. P. Flockton.

Industrial League and Council.—Wednesday, January 11th. At Caxton Hall, S.W. At 7.30 p.m. Lecture on "A Fair Day's Work for a Fair Day's Pay," by Mr. R. Stelling.

Paisley Association of Engineers.—Wednesday, January 11th. At the Y.M.C.A. Buildings, 25, High Street. At 7.30 p.m. Paper on "Hints on the Organisation of Small Shops," by Mr. R. W. Dodson.

Liverpool Engineering Society.—Wednesday, January 11th. At the Royal Institution, Colquitt Street. At 8 p.m. Paper on "Wireless Telegraphy in the Mercantile Marine," by Capt. J. A. Slee, R.N. (retired).

Optical Society.—Thursday, January 12th. At the Imperial College of Science, South Kensington. At 7.30 p.m. Ordinary meeting.

Chelmsford Engineering Society.—Thursday, January 12th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Production Records," by Mr. H. Church.

Manchester Wireless Society.—Thursday, January 12th. At the Albion Hotel, Piccadilly. At 8 p.m. Paper on "The Electric Arc," by Mr. J. C. A. Reid.

Junior Institution of Engineers.—Friday, January 13th. At Caxton Hall, S.W. At 8 p.m. Lecturette, "Artificial Ice," by Mr. E. C. West.

(Midland Section).—Tuesday, January 10th. At the Birmingham Chamber of Commerce, New Street. At 7 p.m. Paper on "Drop Forgings," by Mr. J. Fearn and Capt. F. W. Spencer.

Edinburgh Electrical Society.—Friday, January 13th. At the Philosophical Institute. At 8 p.m. "A Chat on Storage Batteries," by Mr. L. Brookman.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

To enable us to complete our replies to queries received this week, we need the names of manufacturers or suppliers of :

Steel cable troughing.
The "OLSO" electric iron.
The "TRIUMPH FOCUSLITE" for photographic and lantern work.
Swan-neck brackets with porcelain back plates.
Actual makers of fancy wood turned and carved table and floor lamps, also brass and wood turned candlesticks (American inquiry).
"UNIQUE" two-way switches.

NOTES.

The Electrical Engineers' Ball, 1922.—It will be remembered that the Electrical Engineers' Ball was revived last year after seven years' suspension during the period of the war. It was held in February, and was a complete success, establishing a new record. It is hoped, however, that this year's even, now that the Ball has been completely restored to its normal place in the engagements of the season, will be a still greater success. It is to be held at the Hotel Cecil on Friday, February 10th, and we give below the names of the strong and representative committee that has the arrangements in hand. The Electrical Engineers' Ball has always stood for at least two good things. First, it affords an opportunity for electrical engineers and their friends to meet under social conditions which are entirely different from those obtaining in any other function of the season; secondly, any surplus revenue is devoted to the I.E.E. Benevolent Fund and the Electrical Trades Benevolent Institution. These are two motives which should ensure a very ready response, but there is also the memory of some of the twelve pleasant functions of the kind which counts for much, and doubtless will influence many to repeat their happy experiences of the past.

It may be mentioned that the Licensing Regulations permit of supper being held this year at 11.30 p.m. This will be an improvement on last year, while in all other respects there is every promise that the entertainment will be fully up to last season's standard.

GENERAL COMMITTEE.

G. L. Addenbrooke.	J. J. McGregor, C.B.E.
H. Alabaster.	H. T. S. McKay.
H. Allcock.	P. V. McMahon.
L. Andrews.	W. L. Madgen.
L. B. Atkinson.	W. Lee Matthews.
O. H. Baldwin.	E. W. Moss.
Geo. Balfour, M.P.	Lee Murray.
J. H. Bowden.	F. H. Nalder.
E. G. Byng.	Sir Wm. Noble.
Sir T. O. Callender.	Col. W. A. J. O'Meara.
R. A. Chattock.	G. W. Partridge.
A. C. Cramb.	T. Petersen.
A. J. Cridge.	F. Pooley.
P. F. Crinks.	P. J. Pybus, C.B.E.
Sir James Devonshire, K.B.E.	M. J. Railing.
T. C. Elder.	L. L. Robinson.
H. W. Fairman.	P. F. Rowell.
Dr. S. Z. de Ferranti.	W. Rutherford.
E. J. Fox.	C. E. Sayer.
E. A. Gatehouse.	H. Scholey, C.B.E.
F. Gill.	S. Sharp.
Jas. Gray.	H. C. Siddeley.
J. P. Gregory.	A. M. Sillar.
A. E. Hadley.	Sir John Snell.
F. B. O. Hawes.	C. P. Sparks, C.B.E.
J. S. Highfield.	G. Sutton.
C. W. Hill.	C. D. Taite.
H. Hirst.	Capt. G. Taylor.
P. V. Hunter, C.B.E.	James Taylor, J.P.
Sir J. Kemnal, K.B.E.	J. M. G. Trezise.
J. E. Kingsbury.	Capt. R. J. Wallis-Jones, O.B.E.
H. M. Leaf.	A. H. Walton.
W. S. Lonsdale.	David Wilson.
A. R. McCallum.	C. H. Wordingham, C.B.E.

EXECUTIVE COMMITTEE.—O. H. Baldwin, E. J. Fox, J. E. Kingsbury, W. S. Lonsdale, P. V. McMahon, A. M. Sillar, C. H. Wordingham, C.B.E., R. J. Wallis-Jones, O.B.E., A. H. Walton.
HON. SECRETARIES : A. M. Sillar, W. S. Lonsdale.
HON. TREASURER : J. E. Kingsbury.

Correction.—In the course of "Electrical Notes from India," published in the ELECTRICAL REVIEW for October 21st, 1921, it is stated on page 549 in the paragraph relating to the streams flowing down the Nilgiri Hills to the plains, that the hydro-electric scheme under which power is supplied to the Government cordite factory was the first of several large schemes to be carried out by the Tata Company. Mr. J. Ellis Jones, M.I.E.E., &c., Electrical Engineer I/C, writing from the Cordite Factory, Hydro-Electric Station, Nilgiries, S. India, asks us to correct this statement. He says :—"Messrs. Tata & Co. had no connection with the scheme; it was carried out by the General Electric Co., Ltd., of Salford, Manchester, in 1901, and both the power house and the electrical plant of the cordite factory for the Government of India."

Appointments Vacant.—Electrical inspector of mines (Rs. 1,200 a month), for the Indian Mines Department; switchboard attendant, for the Borough of Nelson Electricity Department. (See our advertisement pages to-day.)

Sterilising Milk Electrically.—Mr. T. W. Simpson, a North Perth (West Australia) milk purveyor, has recently been experimenting with the sterilisation of milk by electricity, and has applied for a provisional patent for a process which he claims will sterilise milk with great rapidity at a small cost, and without affecting its digestible qualities. With a small working model he gave a demonstration in October last at the Department of Public Health, the Government Bacteriologist and Pathologist (Dr. Shearman) supplying a sample of milk known to be heavily infected with bacteria. A portion of this milk was treated by the process and was afterwards submitted to bacteriological examination, and though it was not found to be completely sterile, the result was sufficiently promising to warrant further investigations. Arrangements are therefore being made for a further test with a large plant which Mr. Simpson has installed at his own milk depot.

Taxing Electric Motors.—What are described as exorbitant sums are being demanded in the form of taxes from the users of electric motors in Dundee. Hitherto the users of these motors, numbering about 500, and varying from a fractional horse power to ten horse power, were exempt from taxation. They were much surprised, therefore, to receive documents from various rating departments claiming assessment upon the motors, which in some cases will, in the course of a few years only, exceed the total amount paid for the machines. A specimen of the new taxation is given by *The Dundee Advertiser* as follows:—A one-horse electric motor is used by a tradesman in a comparatively small way of business. The Inland Revenue authorities send in a yearly valuation of £1 5s., and claim 6s. assessment yearly under Schedule A; the Parish Council follows up with an assessment of 4s. 11d.—2s. 5d. as owner and 2s. 6d. as occupier; and finally comes the city taxation authority and demands 4s. 10d. as occupier and 1s. 7d. as owner—3d. in this case being added for water. Thus a sum of 17s. 4d. annually is claimed as taxes upon a tiny motor used only occasionally by the owner. The taxation of course increases pro rata according to horse power.

According to an official, the new system of rating was provided for under Section 42 of the Lands Valuation (Scotland) Act, 1854, as amended by Section I. of the Lands Valuation Amendment Act, 1902. According to these Acts all machinery "for the purpose of producing or transmitting first motive power is heritable," and thus electric motors come within the taxable ambit. The rateable charge on these machines is 3s. 4½d. per £1 valuation on owners and 7s. on occupiers. It was only last year that a survey of the city was made with the object of ascertaining all those who used electric motors, and the taxation was imposed for the first time this year. It is said that the attitude of a number of electric motor users in Dundee is that rather than pay the tax they will get rid of the motors.

Australian Standardisation Schemes.—Proposals for work considered by Mr. G. H. Knibbs, director of the Institute of Science and Industry, to be of fundamental importance to the Australian engineering industries have been placed before him by representatives of the Australian Institution of Engineers.

A commencement has already been made in standardising work, the Institute having issued standard specifications for Australia for railway rails, tramway rails, and for steel used for constructional purposes; but in order that it may be developed and carried on in a comprehensive and systematic manner it is necessary that some representative organisation should be established to direct the movement. It is proposed to hold a special Engineering Standards Conference in Melbourne in February, when representatives of the Institute of Science and Industry, the Australian Institution of Engineers, the Australasian Institution of Mining and Metallurgy, and the Australian Chemical Institute will consider a definite plan for establishing an Engineering Standards Committee.

Fatality.—John C. Young, a labourer, while finishing work on an electric crane at the works of Messrs. Babcock and Wilcox, Renfrew, overbalanced and caught hold of a "live" wire. He received a severe shock, and death was instantaneous.

Electric Furnaces in Canada.—According to the *Electrical News* (Canada), the Department of Mines of the Dominion Government has issued a folder dealing with the metallurgical works of the Dominion, giving a list of the users of furnaces, their type, &c., which shows that there is a goodly number of electric furnaces in Canada, including 21 in Quebec (the largest being of 7-ton and the smallest of 1-ton capacity); 22 in Ontario (the largest being of 6-ton and the smallest of ½-ton capacity); two 2-ton furnaces in Manitoba; and five in British Columbia (the largest being of 6-ton and the smallest of 1-ton capacity). A tin smelter is also operated by Electro Tin Products, Ltd., of Brantford, Ont., where one Cobb 2-ton electric furnace is used.

Radium in England.—It is reported that pitch-blende deposits have been discovered in Devon and Cornwall. Too little of the ore has been assayed to enable an opinion to be formed as to the commercial possibilities of radium extraction, but views of experts appear to be favourable.

A Kinematograph Exhibition.—The closing of the winter term at the Finsbury Technical College was marked by an original and most interesting kinema lecture, given on December 9th before the entire staff and students of the Engineering Faculty. The chair was taken by Mr. J. H. Catterson-Smith, chief electrical lecturer. The film and projector were very kindly loaned by the British Thomson-Houston Co., Ltd., Rugby, and showed the manufacture at Rugby of a B.T.H. Curtis turbo-alternator, illustrating step by step the various processes in the manufacture of both turbine and alternator, until the complete set is seen running under working conditions. The film included scenes in the manufacture of a 40,000-h.p. turbo-alternator, the largest power unit yet constructed in Great Britain.

At the close of the lecture the Chairman thanked Mr. B. E. Williams, third year electrical student, for his efforts in bringing about what had been a most instructive and interesting afternoon. He also expressed thanks to the British Thomson-Houston Co., Ltd. It is hoped that the college will purchase a projector of its own during the present session.

The Stiffness of Poles for Overhead Transmission Lines.—ERRATUM.—In the article on p. 9 of this issue, fourth line from foot of first column, the expression "$d \cdot x \cdot s$" should read "$d \cdot s$."

A Heart Beat Recorder.—Perfection of a device which will record the sound of a human heart or a heart beat on a steel wire, from which it can be accurately reproduced at any time, is announced by the United States Bureau of Standards. The work was undertaken at the request of the army medical service, which explained that permanent records of unusual conditions of heart and lungs were desired for clinical instruction. The device comprises the use of an ordinary telephone transmitter and a stethoscope, the current generated by the beat of the heart being "amplified and impressed on a steel wire telegraphone which has the different sounds impressed upon its spool of wire in the form of varying degrees of magnetisation."—*T. and T. Age.*

Fire:—Damage estimated at £5,000 was caused by fire recently at the premises of Messrs. McCosh & Devine, electrical, motor, and general engineers, 57, Peel Street, Bridgeton, Glasgow.

Portsmouth Dockyard Fire.—Several thousands of pounds' worth of damage was done by a fire at Portsmouth Dockyard early on December 27th. The motor test room and the armature repair shop, which contained valuable apparatus, were burned out, but the adjoining workshops were saved after a three-hours' fight, says the *Daily Mail.*

Concert.—The first annual Bohemian concert of the Melby Sports Club (P.O. Engineering Department) is to be held at the Talbot Restaurant, London, on January 14th. The headquarters of the club is P.O. Telegraphs, Moorgate Street Buildings, London, E.C. Mr. C. W. Judd, of 17, Clacton Road, Walthamstow, E.17, is acting as concert secretary.

INSTITUTION NOTES.

Institution of Electrical Engineers. — COMMEMORATION MEETING.—For the purpose of commemorating the first meeting of the Society of Telegraph Engineers, which was held on February 26th, 1872, the Council of the Institution of Electrical Engineers (originally the Society of Telegraph Engineers), is arranging for the following Institution functions to be held on dates approximately corresponding to that of the original meeting:—

Tuesday, February 21st, at 4 p.m.—Popular lecture (admission by ticket, a limited number of seats being reserved for guests) by Professor J. A. Fleming, F.R.S., on "Michael Faraday and the Foundations of Electrical Engineering."

Tuesday, February 21st, at 7 p.m. (for 7.30 p.m.).—Annual dinner at the Hotel Cecil.

Wednesday, February 22nd, at 8.30 p.m.—Professor Fleming will repeat his lecture of the previous day.

Thursday, February 23rd, from 4 to 6 p.m. and from 8 to 10 p.m.—A number of members of the Institution and others closely connected with the early development of electrical engineering will give short discourses on their reminiscences and experiences during the early history of the electricity supply industry. The speakers will deal with matters of scientific and technical interest, and also with the effect of legislative action on the progress of the industry.

This is only a preliminary announcement, and full particulars will be published later.

KINEMATOGRAPH EXHIBITION.—At an ordinary meeting of the Institution, on Thursday, January 12th, the following kinematograph films will be exhibited: "Investigations and Tests on High-tension Switchgear," by Mr. P. Torchio, with explanatory notes by Dr. C. C. Garrard; "Telephone Inventors of To-day," exhibited by Mr. F. Gill; "The Audion," exhibited by Mr. F. Gill; and, if time permits, "Electricity in the Home," exhibited by Mr. F. Gill.

SUMMER MEETING.—Arrangements are being made for a summer meeting to be held at Glasgow and the Western Highlands in May or June next. The programme will be similar to the one that was arranged for the meeting which was to have been held last year.

BIBLIOGRAPHIES OF SPECIAL SUBJECTS.—Members who have compiled bibliographies or reference lists of special subjects are invited to send particulars of them to the secretary, the intention being to keep a note of all such bibliographies and lists in the institution library, with a view to making it possible for members desiring information on particular subjects to be put into communication with those in a position to supply it. When it is possible to present to the Institution an actual bibliography or list, or a copy of it, the Council would greatly appreciate the gift, as the utility of the arrangement would thereby be greatly extended.

PREMIUMS FOR STUDENTS' PAPERS.—In future a maximum of six students' premiums of £10 may be awarded each year.

SCOTTISH CENTRE.—An ordinary general meeting will be held on January 10th, at 7 p.m. A paper on "Induction-Type Synchronous Motors" will be read by Mr. L. H. A. CARR.

The committee has decided to resume the annual dinners, which have not been held since 1913. The function has been fixed for February 28th, at the Grosvenor Restaurant, Glasgow. Tickets (price 17s. 6d. each, exclusive of wines) may be obtained either from the hon. secretary or Mr. W. L. Winning, 166, St. Vincent Street, Glasgow.

Edinburgh Electrical Society.—At a meeting held on December 23rd, Mr. D. S. Munro presided. A lecture on "Watts on wheels (Automobiles and Accumulators)" was delivered by Mr. E. O. Catford. The lecturer described in detail the action and construction of automobile accumulators. The lead and the "Edison" cells were compared, and diagrams of their respective performances submitted. Battery accessories and systems of automobile wiring were discussed, and the lecture was illustrated by many pictures of electrical gear applied to road traction and lighting purposes.

Finsbury Technical College Old Students' Association.—A smoking concert will be held at the Engineers' Club, W., on January 27th. The chair will be taken by the president (Mr. W. G. Head, M.I.Mech.E.) at 8 p.m. Mr. L. M. Clark, A.I.C., has kindly undertaken the arrangement of the musical programme. The committee has arranged for an informal dinner. The hon. sec. should be notified seven days beforehand. Early application for tickets (price 2s. 6d. each) should be made to members of council or to Mr. H. P. Guy, hon. secretary.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

As he is forming a company to acquire the Beachley Power Station, from which it is proposed to supply power for industrial purposes throughout the adjacent Forest of Dean coalfield, Mr. W. T. KERR, the electrical engineer to the Hereford Corporation, has sent his resignation in to the City Council. Mr. Kerr will be leaving Hereford in about two months' time. The Dutch Electrical Engineers, representatives of whom visited Hereford in May last, have sent a message of cordial appreciation to Mr. Kerr for the reception given to them on that occasion.

MR. WILLIAM BLOGG, who has been district manager for the Sterling Telephone Co. for the past seven years (five in Newcastle and two in Cardiff), announces that he has left the company to join the staff of the North British Engineering Equipment Co., Milburn House, Newcastle-on-Tyne. Mr. Blogg, who is closely interested in telephone and signalling apparatus and in the sale of general electrical supplies, will shortly be taking up residence in the North of England.

MR. LIONEL JENKINS, of Bury St. Edmunds, engineer to the West Suffolk County Council, who has been appointed borough engineer of Newport (Mon.) at a salary of £1,000 per annum, will be remembered in connection with the construction of the Middlesex light railway and tramway system.

MR. P. M. ROBINSON, M.I.E.E., A.M.I.Mech.E., was recently appointed general manager of the Eastern Smelting Co., Ltd., with headquarters in Penang, F.M.S. He still retains his connection with the Malacca Electric Lighting Co., Ltd., to which he acts as consulting engineer, as well as being chairman of the board of directors.

MR. ERNEST MURPHY, son of Councillor H. Murphy, of Padiham, has been appointed to the newly-created position of assistant general manager of the mechanical, electrical, and roadway departments of the United Traction Co., Albany, N.Y., U.S.A. Mr. Murphy has been equipment superintendent for the company since 1917. He will now co-ordinate the technical engineering work of the concern under one head. Mr. Murphy secured his degrees in electrical and mechanical engineering at Manchester University. He began his career with the London Metropolitan Railway, and was connected with the electrification of London tramways. His first position in the States was with the Chicago Elevated Railways, where he specialised in automatic control. Subsequently he was appointed superintendent of the electrical department of the Inter-Borough Rapid Transport Co., New York.

Few men in the electrical contracting department of the industry are better known than Mr. LEONARD G. TATE, the secretary of the Electrical Contractors' Association (Incorp.). It is nearly seventeen years ago (February, 1905) since he accepted the position of hon. secretary to the Association, which had been incorporated in the previous year. He held that honorary position until November, 1918, when he sold his interest in the electrical contracting business known as Leonard G. Tate & Co. (under which title he had traded from 1894), and became whole-time secretary of the Electrical Contractors' Association (Inc.) and its Allied Associations. Mr. Tate joined the London Electrical Contractors' Association in 1902, and from then to the date of incorporation was on the governing body of that Association. In 1914 the London Electrical Masters' Association was formed to deal with labour questions which the E.C.A. could not discuss, and he held the secretaryship of that Association until the National Federated Electrical Association was formed, which federated all the local Masters' Associations that had been formed for a similar purpose. His career in the electrical industry began when he joined the firm of Pilsen Joel & General Electric Engineering Co., Ltd., in Kentish Town, in February, 1883. He was engaged in the incandescent lamp department first under the late Mr. Margary, and afterwards with the late Mr. Chas. Robertson, who gave his name to the Robertson lamp later manufactured by the General Electric Co., Ltd. In July, 1884, Mr. Tate was offered the position of manager to the incandescent lamp department of the Schuyler Electrical Co., of Hartford, Conn., U.S.A., and spent five years in the U.S.A. with that company, the Thomson-Houston Co., of Lynn, and other manufacturers. It was in the autumn of 1889 that Mr. Tate became an Associate Member of the Institution of Electrical Engineers, and he has been a member continuously ever since. In the autumn of 1889 he also joined the Brush Electrical Engineering Co., Ltd., and was engaged in the estimating department under the late Mr. Dawbarn, and remained with that company until July, 1892, with the exception of six months spent in the U.S.A. In July, 1892, Mr. Tate joined Mr. Geo. Leslie Fuller, and they traded together as electrical contractors under the name of "Fuller & Tate" at 20, Bucklersbury, E.C. This firm was

Elliott & Fry [*London.*

MR. LEONARD G. TATE.

dissolved in 1894, and from that time Mr. Tate traded as Leonard G. Tate & Co. until 1918, when, as already stated, he gave whole-time attention to association interests. Mr. Tate may be regarded as an expert of the first rank with regard to the manifold problems that have arisen affecting electrical contracting interests, and that branch of the industry owes much to his unfailing activities in its behalf.

After 15 years as advertising manager of *The Electrician*, Mr. W. E. WARRILOW, A.M.I.E.E., severed his connection with that journal on December 31st. He entered the industry in 1894, and though trained in municipal electricity supply and manufacturing, he showed a natural bent for journalism, and has been identified with the electrical Press since 1903. Since 1906 he has been with *The Electrician*, at first on editorial work and subsequently in organising and managing the advertising department. So long an association with journalism has made him a wide circle of friends, and they will be interested to know that he contemplates applying his experience on the agency side of the industry. His definite plans will be announced later, but in the meantime he is to be found at the Engineers' Club, Coventry Street, London.

New Year Honours.—In the list of New Year Honours announced on Monday last a baronetcy is conferred upon Hugh Reid, Esq., chief managing director and deputy chairman of the North British Locomotive Co., Ltd.; Prof. W. A. Herdman, past president of the British Association, receives the honour of knighthood, as does also Mr. Alexander Richardson, M.P., of Engineering, Ltd. Mr. F. J. Brown, head of the Telegraph Branch of the G.P.O., is appointed C.B. (Civil Division); and Mr. J. W. Meares, Electrical Adviser to the

Government of India, receives the honour of C.I.E. Prof. C. S. Sherrington, president of the Royal Society, is made a Knight Grand Cross of the Order of the British Empire. To all of these the ELECTRICAL REVIEW offers its hearty congratulations.

Obituary.—MR. J. E. RENDELL-BAKER.—The death has taken place at Bolton of Mr. J. E. Rendell-Baker, a former manager of the Electricity Works at Stratford-on-Avon, at which he was succeeded a short time ago by his brother.

NEW COMPANIES REGISTERED.

Patent Electric Boiler Scaling Co., Ltd. (178,502).—Private company. Registered December 19th. Capital, £500 in £1 shares. To take over the business of boiler cleaners carried on by J. Townson and R. Townson at Charter Street, Oldham, as the "Patent Electric Boiler Scaling Co." The first directors are: J. Townson, 28, Samson Street, Oldham; R. Townson, 129, Edge Lane Road, Oldham. Qualification, £100. Solicitors: Joseph Tayler & Buckley, 24, Clegg Street, Oldham.

Lorival Manufacturing Co. (1921), Ltd. (178,495).—Private company. Registered December 19th. Capital, £10,000 in £1 shares. To carry on the business of manufacturers of chemicals of all kinds, electrical appliances and accessories, &c., and to adopt an agreement with M. Huntley. The subscribers (each with one share) are: H. J. T. Mitchell, 52, Bishopsgate, E.C., accountant and cashier; E. E. Cooper, 52, Bishopsgate, E.C.2, typist. The subscribers are to appoint the first directors. Remuneration as fixed by the company. Solicitors: Maxwell & Co., 52, Bishopsgate, E.C.

Projector Publicity Co., Ltd. (178,533).—Private company. Registered December 20th. Capital, £500 in £1 shares. To carry on the business of dealers in all kinds of electrical fittings and devices, electric novelties for advertising, &c. The first directors are: Max Gerson, 94, Hatton Garden, E.C.1, diamond merchant; Horace Fletcher, 6, Lancaster Court, Newman Street, Oxford Street, W.1, general merchant. Qualification, £1. Solicitors: Godfrey & Robertson, 40, Chancery Lane, W.C.2.

Frank Craft (Castleford), Ltd. (178,523).—Private company. Registered December 20th. Capital, £5,000 in £1 shares (2,000 10 per cent. cum. pref.). To take over the business of an electrical and consulting engineer and contractor carried on by F. Craft at 56a, Carlton Street, Castleford, as "Frank Craft." The permanent directors are: F. Craft (managing director), Carr Lane, Glasshoughton, Castleford; Mrs. Mary I. Craft, Carr Lane, Glasshoughton, Castleford, Yorks. Qualification, £50. Remuneration (except managing director) as fixed by the company. Registered office: Central Chambers, 56a, Carlton Street, Castleford.

Amesbury Electric Light and General Supply Co., Ltd. (178,421).—Registered December 16th. Capital, £5,000 in £1 shares. To generate and supply electric current for light, power, and otherwise in or near Amesbury, Wilts. The first directors are: H. C. James, West Amesbury Road, Amesbury, Wilts (chairman); J. O. March, Countess Road, Amesbury, Wilts.; Sir Cosmo Gordon Antrobus, Bart., Amesbury Abbey, Amesbury, Wilts.; A. Sloan, High Street, Amesbury, Wilts.; L. Binns, High Street, Amesbury, Wilts. Minimum cash subscription, £3,500. Qualification, 25 shares. Remuneration as fixed by the company. Secretary: S. N. Bigwood. Registered office: South Mill, Amesbury, Wilts.

Corona Lampworks (Southern), Ltd. (178,554).—Private company. Registered December 21st. Capital, £100 in £1 shares. To carry on the business of manufacturers of and dealers in electric bulbs, lamps, fittings, appliances, bells, batteries, accumulators, accessories, plant, and machinery, &c. The permanent directors are: A. S. Tanner, 69, St. Paul's Road, Camden Square, N.W.1, sales manager; Mrs. J. M. Tanner, 69, St. Paul's Road, Camden Square, N.W.1. Qualification, £24. Remuneration as fixed by the company. Registered office: 39, St. Albans Road, Woodford, Essex.

Meegan & Watson, Ltd. (178,699).—Private company. Registered December 29th. Capital, £2,000 in £1 shares. To take over the business of electrical and general engineers, wholesale and retail dealers in electrical goods and appliances carried on by H. Meegan and L. Watson at 44, Lowtown, and Robin Lane, Pudsey, as "Meegan & Watson," and to carry on the business of mechanical and general engineers, machinery and engine boiler makers, iron and brass founders, dealers in electrical goods and appliances, motor cycles and vehicles, &c. The first directors are: H. Meegan, 11, St. Lawrence Terrace, Pudsey; L. Watson, 12, Fern Terrace, Thorpe Road, Pudsey; S. Webster, West Villa, New Street, Harsley. Qualification, 100 shares. Secretary (pro tem.): G. Rowson.

A. Smethurst & Sons, Ltd. (178,542).—Private company. Registered December 21st. Capital, £6,000 in £1 shares. To carry on the business of electricians, mechanical engineers and manufacturers, workers and dealers in electricity, motive power and light, &c., and to adopt an agreement with A. A. Smethurst. The permanent directors are: A. A. Smethurst, Milton Lodge, Milton Road, Woolston, Southampton; Beatrice F. Smethurst, Milton Lodge, Milton Road, Woolston, Southampton. Qualification, 50 shares. Registered office: 16, Bernard Street, Southampton.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Thomson-Houston Co., Ltd.—Trust deed dated November 30th, 1921, to secure £3,000,000 deb. stock at 4½ per cent. on £1,500,000; the amount of the present issue has been filed pursuant to Section 93 of the Companies (Consolidation) Act, 1908. Property charged: Freehold and leasehold properties and company's other assets, present and future, including uncalled capital; subject to trust deed dated March 10th, 1902. Trustees: Royal Exchange Assurance Corporation.

Notting Hill Electric Lighting Co., Ltd.—Particulars of £25,000 7½ per cent. seven years' notes, authorised November 1st, 1921; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital; subject to outstanding 4 per cent. first mortgage debentures.

Calcutta Tramways Co., Ltd.—Second debenture, dated December 13th, 1921, to secure £150,000; charged on the company's undertaking and property, present and future, including uncalled capital; subject to trust deed dated June 4th, 1921, securing £350,000 4½ per cent. first debenture stock. Holders: Lloyds Bank City Office Nominees, Ltd.

Oswestry Electric Lighting and Power Co., Ltd.—Satisfaction in full on November 1st of debentures, dated October 11th, 1921, securing £800.

Jesmond Electrical and General Engineering Co., Ltd.—Debentures dated December 7th, 1921, to secure £300; charged on company's property, present and future, including uncalled capital. Holder: J. Sharp, 29, Armstrong Avenue, Newcastle-on-Tyne.

Dawlish Electric Light and Power Co., Ltd.—Satisfaction to the extent of £300 on June 3rd, 1921, of mortgage debenture dated September 24th, 1920, securing £2,000.

Taranto Tramways and Electric Supply Co., Ltd.—Charge on concession and rights and the company's undertaking and property, present and future, including uncalled capital, dated December 20th, 1921, to secure £20,000. Holders: Commercial Bank of Scotland.

Sevenoaks and District Electricity Co., Ltd.—Issue on December 13th, 1921, of £14,900 debentures; part of a series already registered.

Coatbridge and Airdrie Electric Supply Co., Ltd.—Further charge on the company's undertaking and property, present and future, including uncalled capital and Coatbridge and Airdrie undertakings, &c., dated December 15th, 1921; supplemental to mortgage dated March, 1904, to secure an additional £5,000. Holders: County of London Electric Supply Co., Ltd.

English Electric Co., Ltd.—Satisfaction to the extent of £30,100 on November 21st, 1921, of first mortgage debentures secured by trust deed dated September 15th, 1919, securing £1,000,000.

Reeve & Bayman, Ltd.—Mortgage debenture dated December 17th, 1921, to secure £2,500; charged on the company's undertaking and property, present and future, including uncalled capital. Holder: E. H. Hawkins, 4, Charterhouse Square, E.C.

Fyfe, Wilson & Co., Ltd.—Mortgage dated December 17th, 1921, to secure £700; charged on certain land and premises at Bishop's Stortford. Holder: Miss E. Gee, Bishop's Stortford.

Rowland Small Tool Manufacturing Co., Ltd.—Mortgage on a sum of £604 13s. and other moneys payable to company under a certain contract with the Air Ministry, dated December 19th, 1921, to secure all moneys due or to become due from company to Lloyds Bank.

British Universal Variable Gears, Ltd.—R. S. Keeler, of 17, Grosvenor Gardens, S.W., was appointed receiver and/or manager on December 13th, under powers contained in mortgage debentures dated May 31st, 1921, in place of G. M. Brown.

Allies Electric Lamp Repairing Co., Ltd.—A. Elliott, of 2, Langdale Avenue, Mitcham, was appointed receiver and manager on December 13th, 1921, under powers contained in debenture dated January 7th, 1919.

Brown, Boveri & Co., Ltd. (89,167).—Return dated December 14th, 1921. Capital, £50,000 in £5 shares. All shares taken up; £21,250 paid on 8,500 shares, being £2 10s. per share (£7,500 considered as paid on 1,500 shares). Mortgage and charges: Nil.

Coniston and District Electric Supply Co., Ltd. (138,478).—Return dated October 15th, 1921. Capital, £2,000 in £1 shares (1,500 6 per cent. pref. and 500 ord.); 1,440 pref. and 500 ord. shares taken up; £1,660 paid; £280 considered as paid. Mortgages and charges: Nil.

L. J. Healing & Co., Ltd. (97,137).—Return dated June 8th, 1921 (filed October 7th). Capital, £100,000 in £10 shares (5,000 pref. and 5,000 def.); 1,301 pref. and 5,000 def. shares taken up; £13,010 paid; £50,000 considered as paid. Mortgages and charges: Nil.

British Arc Welding Co., Ltd. (108,759).—Return dated October 4th, 1921. Capital, £50,000 in £10 shares; 1,474 shares taken up; £12,740 paid; £2,000 considered as paid. Mortgages and charges: Nil.

Direct West India Cable Co., Ltd. (53,986).—Return dated October 6th, 1921. Capital, £120,000 in £5 shares; 12,000 shares taken up; £60,000 paid. Mortgages and charges: Nil.

Birmingham District Power and Traction Co., Ltd. (19,077).—Return dated July 6th, 1921. Capital, £700,000 in £1 shares (250,000 pref. and 450,000 ord.); 146,846 pref. and 412,984 ord. shares taken up; £559,780 paid. Mortgages and charges: £348,888 4½ per cent. ord. and 40,000 6 per cent. second debenture stock.

Europe and Azores Telegraph Co., Ltd. (39,452).—Capital, £200,000 in £10 shares. Return dated November 2nd, 1921. All shares taken up; £144,320 paid; £55,680 considered as paid. Mortgages and charges: Nil.

Church Stretton Electric Supply Co., Ltd. (80,857).—Capital, £10,000 in £1 shares. Return dated September 28th, 1921. 8,154 shares taken up; £154 paid; £8,000 considered as paid. Mortgages and charges: £6,400.

Reno, Ltd. (117,987).—Capital, £5,000 in £1 shares (1,000 pref. and 4,000 ord.). Return dated December 31st, 1920; filed September 12th, 1921. 800 pref. and 4,000 ord. shares taken up. Mortgages and charges: Nil.

CITY NOTES.

Ferranti, Ltd.

Mr. A. W. Tait, C.B.E., presided at the annual meeting held on December 29th at Basildon House, London, E.C. He said that the net profit for the year to June 30th, 1921, was £36,268, after making provision for general establishment charges, bad debts, repairs and renewals, interest on debenture stock, notes and loans, and making the usual allocation of £10,000 to depreciation reserve, and providing for E.P.D., Corporation Tax, and Income Tax. The net profit for the previous year on the same basis was practically the same figure, namely, £36,622. The balance on trading account was £141,175, as against £131,949 in the previous year. This increased trading profit had, however, been practically all absorbed in making the necessary provisions for taxation. This was a growing burden so far as their company was concerned, and the provision which had been included in the accounts would fully cover their liability in this regard. The accounts comprised the last accounting period for the purposes of E.P.D. They had practically agreed the figures with regard to taxation up to June 30th, 1920, and, in respect of the year to June 30th, 1921, the figures were well advanced and proper provision had been made. He trusted that something would be done to lighten the heavy load of taxation in this country, which bore so heavily on industry at a time of world-wide depression and the necessity of obtaining orders in the markets of the world in the face of keen international competition. At the last annual meeting he mentioned that the year to June 30th, 1920, commenced a new era in the affairs of the company. It was the first full year in which they had consolidated their efforts in the production of three definite lines of manufacture, namely, meters, power transformers, and measuring instruments. The output in that year was the best which the company had ever accomplished,

excluding, of course, the war period. The year to June 30th, 1921, showed continued progress, and the output for that year exceeded the output of the previous year by over 27 per cent. In common with other manufacturers they had experienced during the past year a considerable falling off in demand, and in consequence a gradual diminution in the total amount of their order book, as a result of which they had had somewhat to slacken down in output. Recently, however, there had been some signs of improvement, which would seem to indicate that the worst period was over, but the improvement would necessarily be slow. In the meantime they were exercising their abilities in the improvement of manufacture, in order to reduce costs to more readily compete, particularly with foreign manufacturers. Their sales organisation was active in its endeavours to obtain business, both in the home markets and abroad. The disorganised condition of exchanges throughout the world placed British manufacturers at a considerable disadvantage, and he hoped that it might be possible, by means of some united effort on the part of all the great countries, to arrive at a scheme whereby exchanges might be more or less stabilised, in order to permit more freely the exchange of commodities and manufactures. In reviewing the company's financial position as at June 30th, 1921, the chairman said goodwill and patent rights, which had stood in the books of the company since its re-organisation at £69,370, had now been written down to the nominal figure of £1 by means of a transfer from the general reserve account. This enabled them to write out from the assets the only intangible item, the real value of which it was always difficult to assess. Their investments stood at £18,937, and represented chiefly the value of their holding in the subsidiary company in Canada. Expenditure on work in hand, and stocks and stores, which amounted together to approximately £207,400, showed a slight decrease on the figures of the previous year. This decrease would have been larger had it not been for the welcome increase in their turnover during the year. Sundry debtors at £159,786 showed an increase of approximately £11,500, which was also a reflection of their increased output. There was a welcome reduction in their liabilities, both secured and unsecured. After carefully considering the position and prospects of the company the directors felt justified in recommending that out of the profits for the year to June 30th, 1921, a dividend of 18 per cent., less income tax, being three years' arrears, be declared on account of the arrears of dividend accrued on the preference share capital of the company. Last year he stated that the board had decided to postpone submitting a definite scheme of reorganisation of the company's capital until general monetary and trade conditions were more favourable, particularly for raising additional working capitatl for the company. This decision was a wise one, and in the time which had elapsed since then conditions had not improved. The board had, therefore, decided to postpone submitting a definite scheme until conditions were more normal. With regard to the present year, it was impossible to make any reliable forecast. He mentioned that there had been a decrease in the volume of orders obtained during the last year, but he hoped that things were now somewhat on the mend, and that they might expect some reasonable increase in business during next year. The electrical industry had, in his opinion, been somewhat fortunate in the recent trade depression which had been experienced all over the world, because, owing to the necessity for reconstruction after the war, and for the development of peace industries, that industry was of vital importance, and would be increasingly so in the future because of the necessity of cheapening the cost of all manufactures, in which process it entered nearly every field of industry.

Dr. S. Z. DE FERRANTI seconded the proposition, and it was carried.

A SHAREHOLDER asked how long it would be before some dividends were declared for the ordinary shareholders. They had, he said, been very patient year after year, and he noticed that a lot of money was being put to the reserve account.

The CHAIRMAN replied that it was impossible to consider the payment of a dividend on ordinary shares until conditions were more normal and they were able to raise additional capital.

The preference dividend resolution was carried.

S. Smith & Sons (Motor Accessories), Ltd.

The report for the year ended July 31st, 1921, shows, according to the *Financial Times*, that, after writing off £28,572 for depreciation on plant and machinery, &c., and writing down stock-in-trade to market prices, and after providing for income tax and adjustment in connection with excess profits duty, there is a loss of £295,437. From this has to be deducted £91,452 brought in, leaving a deficit to be carried forward of £203,985. An issue of £600,000 8½ per cent. first mortgage debentures was authorised, and of these there has been issued £65,100 at 95 per cent. to shareholders and £520,000 has been deposited with the company's bankers as security for advances. At the commencement of the year the company had a large volume of orders on hand, and had corresponding commitments for raw material to meet the demand. Owing to the world-wide depression which developed shortly afterwards, a difficult position arose. Large stocks for which there was no immediate demand, depreciated heavily in value, and the directors have considered it advisable to write off the whole of the loss, which accounts chiefly for the deficit shown. In addition the failure of several of the largest manufacturers of motor cars involved the company in considerable loss in respect of bad debts, which have also been written off. These losses, together with the suspension of contracts, have been responsible for the position disclosed. Depression in trade has affected the subsidiary companies, and no dividends have been received from this source. The board does not consider the present time opportune to make definite recommendations for dealing with the adverse balance, and it has been decided accordingly to postpone this subject for future consideration.

French Companies.

The *Société d'Exploitations Electriques* reports net profits of 953,000 fr. for 1920-21 and a dividend at the rate of 7 per cent., less tax.

The *Société Anonyme Electro-Cable* reports that the increase in the share capital effected in 1920-21 enabled the company to acquire the various works of M. H. Debauga. The turnover continued on a rising scale and the different works gradually recovered from the general crisis and regained their former vitality. That at Argenteuil, which is equipped for the rolling, drawing and twisting of copper, received considerable additions to the plant in view of the deliveries to be made in connection with the electrification of the railways; and the output there now amounted to 1,500 tons per month. The works in the Rue des Bois, Paris, which specialises in the manufacture of insulated wires and cables, would permit of the production of a minimum length of 2,000,000 metres per month. A similar output capacity would apply to the Angreville works, when completed, which was designed to complement the works in the Rue des Bois. The net profits realised in 1920-21 amounted to 1,611,000 fr., and the dividend is at the rate of 50 fr. per share, as against 55 fr. in 1919-20.

The report of the *Compagnie Générale d'Electricité* states that the diversity of the manufactures of the industrial works and the general recovery experienced by the company's undertakings for the distribution of electrical energy rendered it possible for the company to bear the consequences of the general economic crisis, which did not affect the results in 1920-21 as seriously as might have been feared. During the year the departments of the Tubes de Vincey and the Lampes d'Incandescence were transferred to separate companies, in which the Compagnie Générale held a considerable interest. The accounts, which were summarised in this journal on December 23rd, were approved at the recent general meeting. At a subsequent special meeting it was decided to increase the share capital from 50,000,000 fr. to 53,571,000 fr. for the purpose of issuing the new shares in exchange for the assets of the Société de l'Accumulateur Tudor, which will thus become merged into the Compagnie Générale.

The *Société Générale d'Entreprises*, reporting on the year 1920-21, states that the construction of hydro-electric works continued to constitute a great part of the company's activity, of which various instances are mentioned. In addition the scope included steam generating stations, of which those at Comines and Gennevilliers would shortly be set in operation. The administration of the Usines Domaniales of the Sarre (Saar coal mines) had appointed the company as architects and consulting engineers for the construction of a great central station of 150,000 kW, and the company had also been entrusted with the extension of the Vitry generating station and the Issy-les-Moulineaux power station for the account of the Union d'Electricité and the Compagnie Parisienne de Distribution d'Electricité respectively. Concerning the department for the establishment of transmission lines, the report mentions that the experience gained in this branch had resulted in the company being entrusted with the study and execution of several large 120,000-volt feeders in the North, Centre, and the South of France. The railway construction department was actively engaged in Spain, while in France, according to recent decisions of various county councils, there was hope of an early resumption of railway work in the Basses-Pyrenées, in the Tarn and the Haute-Garonne. On the other hand, the company was pursuing an active policy of extension outside France, both in Eastern Europe, particularly Rumania, and in the African colonies, where interesting contracts for projects had been received from the competent authorities. In particular the company had participated in the creation of the Société Tunisienne d'Entreprises, of which the company had the control. The company had also participated, in conjunction with other firms undertaking public works, and with the co-operation of powerful banks, in the formation of various syndicates for the profitable utilisation of the colonies, such as the Camaroons railway and the hydraulic powers in Morocco. In addition the company had been charged by the Government of French West Africa with a mission to study on the spot and prepare schemes for the electrification of the great railway from Kayes to the Niger and the establishment of "falls on the Senegal and on the Niger." The net profits earned in 1920-21 amounted to 1,938,000 fr., and a dividend at the rate of 10 per cent. has been declared on share capital of 15,000,000 fr., which has since been raised to 30,000,000 fr.

The *Energie Electrique du Sud-Ouest* has decided to raise its capital from 30,000,000 to 50,000,000 fr. by the issue of 40,000 500-fr. preference shares. The increased capital is mainly for the purpose of meeting the cost of the construction of the high-pressure line to serve the new wireless stations at Croix d'Hins and Arcachon.

The London Underground Pool.—*The Times* of December 29th contains information respecting the reasons for the revision of the Common Fund agreement of the London underground railway and associated companies. Some of the undertakings have substantially increased their traffic since the 1915 agreement came into force, and these and other circumstances calling for a change in the percentages for distribution, it was decided to simultaneously effect other alterations which experience had shown to be necessary.

Humphrey Pump Co., Ltd.—The directors' report of the year ended September, 1921, says that the accounts show a debit balance of £2,397, making the net debit balance £52,570.

Shanghai Electric Construction Co., Ltd.—Second interim dividend at the rate of 6 per cent. actual (12s. per share) less tax.

Stock Exchange Notices.—The undermentioned securities have been ordered to be officially quoted:

Yorkshire Electric Power Co.—£130,000 5½ per cent. redeemable redemption stock.

STOCKS AND SHARES.

TUESDAY EVENING.

AT the beginning of a year the annual recurring difficulty presents itself of how to render sets of tables interesting. The simplest way would be, naturally, to leave them out altogether: the uneasy wonder whether anybody troubles about price-catalogues is always present to the conscientious compiler of quotations. Yet it is certain that many investors, and others, do like to observe the trend of a year's movements in stocks and shares. By way of adding to the ordinary bald record of the 1921 comparisons, we add the December 31st prices for 1918 and 1919. This enables an idea to be obtained of the position as it stood at the end of the war, matched against the market values of to-day, in the cases of representative stocks and shares. The principal markets dealt with in these notes fall into four groups, as follows:—

ELECTRICITY SUPPLY SHARES.

Ordinary.	1918.	1919.	1920.	1921.	Rise, 1921.
Brompton	7⅛	5⅞	6	6⅜	⅜
Charing Cross	8⅜	9⅛	9⅜	4⅜	14
Chelsea	4	3	3¼	3¼	¼
City of London	13	12	12	1⅞	-⅛
County	1⅛	9½	7⅞	8⅝	1⅛
Kensington	5¼	4⅜	3¼	6¼	1½
London	1⅛	1⅛	⅞	1	⅛
Metropolitan	3	3	2⅜	3⅜	1½
St. James'	7⅛	6	6¼	6⅜	¼
South London	8	2½	2¼	2⅜	⅜
Westminster	7½	5¼	4½	5⅞	1⅜

TELEGRAPHS, &C.

Stock or share.	1918.	1919.	1920.	1921.	Rise or fall. 1921.
Anglo-American Pref.	99	90½	75¼	84¼	+ 9
Eastern Extension	15⅛	16⅜	14⅜	16⅜	+ 1⅜
Eastern Telegraph	157½	162½	152⅛	166¼	+14
Globe Ord.	14½	16⅛	14⅜	16⅛	+ 1⅜
Great Northern	33	28⅜	20⅜	26½	+ 6
Indo-European	52½	49⅜	30	27⅜	− 2⅛
Marconi	4⅜	4⅜	2⅞	1⅛	− ⅜
United River Plate	7⅜	7⅜	5⅞	5⅞	—
West India and Panama	1½	1⅛	⅞	⅜	− 7/8
Western Telegraph	16½	17½	14½	16⅝	+ 1¼

RAILWAY STOCKS AND SHARES.

Stock or share.	1918.	1919.	1920.	1921.	Rise, 1921.
Central London Ord.	65½	58½	49½	51½	2
Metropolitan	31½	25½	20	26½	6½
District	26	21	15¼	21½	6
Underground Ord.	3⅜	2⅛	1⅞	2	⅛
,, A	8/9	6/6	5/-	6/-	1/-
,, Inc.	92½	81	60½	75½	15

MANUFACTURING.

Share.	1918.	1919.	1920.	1921.	Rise or fall, 1921.
Babcock	3½	3⅝	2⅛	2⅜	+ ⅛
British Aluminium	1⅜	1⅜	17/6	15/-	− 2/6
British Westinghouse Pref.	2½	2⅛	1½	1⅜	− 1/8
Callender's	10⅛	8⅛	1⅜	1⅜	− ⅛
General Electric	17½	2	19/6	18/3	− 1/3
Henleys	2½	2⅛	1⅞	29/6	+ 5d.
India Rubber	17	1⅜	⅞	⅝	− ⅛
Telegraph Construction	48	26½	20½	21½	+1

It is of peculiar interest to notice that every one of the electricity supply shares has risen, on balance, during the year just ended. The reason lies in the fact that the companies' last reports showed surprisingly good results, and these led to an increased confidence on the part of investors, which caused ready absorption of any shares that came to market. During the last few months of 1921 a long-continued and very substantial rise in War Stock and other gilt-edged securities led to a general widening of demand for sound investments. New issues of sound character have found ready acceptance. The year concluded with good premiums upon many of the debentures, &c., offered by electrical companies during the period.

When the ordinary shares in manufacturing companies come to be considered, the effects of trade depression, chaotic foreign exchanges and depreciation of stock become more evident. Electrical trades have suffered like everything else, but it is difficult to show useful comparisons in more than a few cases owing to the way in which capital accounts have been re-arranged and re-organised during the four years. Some companies split their shares. Callender's is an example in point, and, in the London lighting list City of London ordinary shares were similarly treated. With Marconis, new shares have been given to proprietors. The Telegraph Construction Co. doubled its capital, and so divided the value of its shares, while the General Electric split the £10 shares into ten of £1 each.

Electrical railway stocks show an unbroken list of gains, ranging from 1s. on Underground "A" to 15 points on the company's Income bonds. The foreign traction list has fared less well. Brazilian Tractions at 31½ are 5½ down on the year, and have almost halved in price as compared with two years ago. Mexico Tramways first mortgage bonds are, however, 17 higher, owing to resumption of dividend payments. British Columbia preferred stock is three points lower than it was in December, 1920.

However unsatisfactory last year proved in too many respects, the above tables demonstrate that matters might have been very much worse than they were in the Stock Exchange experience of prices in the markets for electrical securities. Matter may be found, indeed, for congratulation in the records here presented. Moreover, the future holds promise of more cheerful conditions, in spite of the many causes for anxiety that still remain. If the various branches of the industry can weather, so satisfactorily as the price-movements indicate, a year like that just concluded, there is justifiable ground for the cordial hope that the New Year may yield increased progress and prosperity to those who are sufficiently patient to follow these weekly comments upon financial events connected with electricity.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend. 1919.	Dividend. 1920.	Price Jan. 3, 1922.	Rise or fall.	Yield p.c.
Brompton Ordinary	12	12	6⅜	+ ⅛	£9 1 2
Charing Cross Ordinary	7	8	4⅜	—	8 18 3
do. do. 4½ Pref.	4½	4½	3½	—	7 4 4
Chelsea	4	6	3½	+ ½	8 11 6
City of London	13	14	1⅞	—	9 14 10
do. do. 6 per cent. Pref.	6	6	18/6	+ 6d.	6 9 9
County of London	8	8	8⅛	+ ⅛	9 0 4
do. do. 5 per cent. Pref.	6	6	7⅛	—	7 10 0
Kensington Ordinary	7	9	5⅛	—	8 16 6
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref.	6	6	8½	—	9 12 0
Metropolitan	6	7	8⅞	—	9 6 8
do. 4½ per cent. Pref.	4½	4½	2⅛	—	7 18 2
St. James' and Pall Mall	12	12	6⅜	—	8 17 10
South London	6	7	2⅜	—	10 9 0
South Metropolitan Pref.	7	7	17/6	—	8 0 0
Westminster Ordinary	10	10	5⅞	—	8 10 2

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	6	6	84½	—	7 2 4
do. Def.	1½	1½	18⅜	—	8 2 2
Chile Telephone	6	6	5⅜	—	5 17 3
Cuba Sub. Ord.	7	7	7	—	10 0 0
Eastern Extension	10	10	16½	—	6 1 2
Eastern Tel Ord.	10	10	166½	+ ½	6 0 1
Globe Tel. and T. Ord.	10	10	16⅛	+ ⅛	6 1 2
do. do. Pref.	6	6	9⅛	—	6 6 6
Great Northern Tel.	22	24	26½	+ ½	9 1 2
Indo-European	10	10	97½	—	9 2 0
Marconi	25	15	1⅛	—	8 13 0
Oriental Telephone Ord.	12	12	2	—	*8 0 0
United R. Plate Tel.	8	8	5⅛	—	*6 16 2
West India and Panama	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	16½	—	*6 1 2

HOME RAILS.

Central London Ord. Assented	4	4	51½	—	7 15 4
Metropolitan	1½	1½	26¼	—	5 16 3
do. District	Nil	Nil	21½	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	2	—	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	4	2	75½	— ½	*3 19 6

FOREIGN TRAMS, &c.

Anglo-Arg. Trams, First Pref.	5½	12½	2⅜xd	—	10 9 6
do. do. 2nd Pref.	Nil	5½	2⅛	—	7 17 3
do. do. 5 per cent. Deb.	5	5	63½	—	7 17 6
Brazil Tractions	Nil	Nil	31½	+ ½	Nil
British Columbia Elec. Ry. Pfce.	5	5	58	—	8 12 4
do. do. Preferred	5	98/-	55½	+ ½	*9 8 0
do. do. Deferred	3	124/-	57½	—	*10 17 0
do. do. Deb.	4½	4½	61¼	—	6 18 2
Mexico Trams. 5 per cent. Bonds	Nil	Nil	55½	—	—
do. do. 6 per cent. Bonds	Nil	Nil	26½	—1	Nil
Mexican Light Common	Nil	Nil	13	—	Nil
do. Pref.	Nil	Nil	27	—	Nil
do. 1st Bonds	Nil	5	61½	—	8 2 8

MANUFACTURING COMPANIES.

Babcock & Wilcox	15	16	9⅜	—	6 14 9
British Aluminium Ord.	10	10	15/-	—	—
British Insulated Ord.	15	15	1½	—	10 0 0
Callenders	15	15	1⅜	—	10 18 2
,, 6½ Pref.	6½	6½	18/9xd	+6d.	6 18 8
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	—	6/-	—	—
do. do. 5 per cent. Deb.	5	5	62xd	—	8 1 4
Electric Construction	10	10	18/8	—	10 19 2
English Electric	8	8	10/-	—	16 0 0
do. Pref.	6	6	11/6	—	9 12 6
Gen. Elec. Pref.	6½	6½	17/3xd	+9d.	7 10 9
do. Ord.	10	10	18/3	—	10 19 2
Henley	15	15	29/3	—	10 5 7
do. 4½ Pref.	4½	4½	3⅜	—	6 4 2
India-Rubber	10	—	⅞	—	—
Met.-Vickers Pref.	8	8	1⅜	—	9 2 10
Siemens Ord.	10	10	1⅞	—	*9 8 2
Telegraph Con.	20	20	21½	—	*5 11 9

* Dividends paid free of Income Tax.

RAILWAY ELECTRIFICATION.

By Sir Vincent L. Raven, K.B.E., M.Inst.C.E., M.I.Mech.E.

(Abstract of paper read before the NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.)

(Concluded from p. 907.)

The North-Eastern Co.'s coal consumption in 1919 was 921,480 tons; if electric working were substituted for steam there would be a saving of about 550,000 tons per annum, and a further saving would be effected due to the fact that the low-grade fuel would be substantially cheaper than the high-grade locomotive coal.

In addition to this, a large proportion of the stand-by fuel losses inherent in steam-engine operation may be eliminated in electric operation. On the Chicago, Milwaukee, and St. Paul Railway it was found that the stand-by fuel losses amounted to 27½ per cent. of the total coal burned. This saving of fuel burned on the steam locomotive has an additional value from the traffic point of view, in addition to the actual saving in the cost of fuel, for the coal that is saved would have had to be carried over the line to a number of engine coaling depots.

With electric operation, a much smaller tonnage of coal has to be carried over any line—for the same traffic—and this quantity is carried to fewer unloading points, namely, the power stations. This results in the clearing from the line of a number of local trains. A number of wagons will also be set free which, with steam operation, would have to be employed in carrying coal. In the example quoted previously where the calculated savings were given, resulting from the electrification of a certain section of line, it was estimated that there would be a saving of 93 40-ton wagons due to the reduction in fuel consumption.

On lines where the gradients are long and severe, the equipments of electric locomotives can be arranged for the generation of power, so that when a train is descending a gradient the motors become electric generators and return power to the distribution system, and in so doing produce a retarding force, holding the train on the gradient without the use of the mechanical brake. This gain is most important on the line where the heavily loaded trains are, in general, running down the grade. The advantages which may be obtained by making use of this regenerative property of electric locomotives consist in—

(*a*) A saving of power and fuel;

(*b*) An increase in the life of the brake blocks;

(*c*) A possible saving in damage to couplings;

(*d*) It is possible to take goods trains down long gradients at a higher speed by using regenerative braking than by relying on the ordinary brakes to control the speed. This is possible partly because the retarding effect of the locomotive when working regeneratively increases if the speed increases, whereas the retarding force due to the brake falls off with any rise in speed. Thus regenerative working is a stable condition, while the action of the brakes is unstable, and if the train once exceeds a certain speed the brakes are powerless to get the train under control again. Further, the speed of a train down a long gradient must not be such as to cause overheating of the brake blocks and wheel tires. With regenerative working the brakes are held in reserve and the speed is only limited to such a value that the brakes can stop the train at any signal if necessary. Again, the regenerative action is continuous and does not tend to fall off after extended use, whereas under certain circumstances the air pressure or the vacuum on which the brakes depend may gradually fall and there may be no opportunity to restore the pressure or the vacuum without letting the train get out of control.

The regenerative braking may be a very definite advantage in certain cases of lines where heavy gradients occur, and it is peculiar to electric operation, no similar effect being possible with steam working.

Electric locomotives show a considerable advantage over steam engines in the cost of repairs and maintenance. Mr. Armstrong, chairman of the Electrification Committee of the General Electric Co., has given the following table of electric locomotive maintenance costs for the year 1919:—

	New York Central Railroad.	Chicago, Milwaukee and St. Paul Rly.	Butte Anaconda and Pacific Railroad.
Annual mileage	1,946,879	2,321,148	566,977
Cost of repairs per mile, cents	6.39	14.65	6.48

As compared with these figures, Mr. Armstrong gives the present cost of maintaining a 2-8-8-2 Mallet steam engine at 60 cents per engine mile, without including many miscellaneous charges not shared by the electric locomotive.

On the Newport and Shildon line, a comparison of costs of repairs has been got out, the steam engines being those which used to work this traffic:—

—	Material.	Wages.	Shop expenses.	Total.	Miles run between repairs.	Cost per mile.
Steam No. 1682, 4-8-0 type freight	£ s. d. 467 9 11	£ s. d. 455 15 3	£ s. d. 341 16 6	£ s. d. 1,065 1 8	51,134	d. 5·00
Steam No. 1355, 0-6-0 type freight	523 1 2	434 0 2	335 10 1	1,293 6 5	56,210	5·532
Electric No. 9, 0-8-0+4-0 type ..	98 9 9	258 5 1	193 14 5	550 9 5	100,10	1·316

It may be noted also that the steam engine had no special renewals due to the boiler, otherwise the cost would have been very much higher.

One reason for this saving in maintenance cost lies in the simplicity and robustness of the electric locomotives. Spare parts can be substituted so easily that heavy repair work is practically confined to cases of serious breakdown or accident—if tire turning is not included. The shops required for maintaining a given number of engines need be much less elaborate than would be required for an equal number of steam engines. Further, it has been possible as a result of electrification—for example on the Chicago, Milwaukee, and St. Paul Railway—to lengthen engine divisions and eliminate intermediate engine depots. The latest passenger locomotives on this line are taken off for inspection after a mileage varying from 3,000 to 5,000 miles.

It may be argued that the whole story is not complete when one compares the maintenance cost of an electric locomotive with that of a steam engine, as there is obviously a charge to be added to the "electric" for generating at the main station, and also transforming at the sub-stations, together with the equipment of the permanent way. To make the whole story complete, the maintenance of the steam engine together with the coal and water used must be compared with the maintenance of the electric engine and rail equipment, and the total cost per unit, which, of course, includes coal and maintenance of generating and sub-stations. In the figures which we have for the N.E.R., the cost of coal and water used by the steam locomotive is about equal to the unit as supplied to the electric locomotive together with the cost of maintenance of permanent way.

On the Chicago, Milwaukee, and St. Paul Railway, it appears that the cost of coal on the locomotives is 40 per cent. greater than the cost of the power delivered to the locomotives; all expenses in connection with generation, transmission, conversion and distribution being included in the cost of power, together with capital charges and depreciation. Therefore, when this is taken into consideration, it would appear that the comparison of cost of maintenance as has been shown between the two types of locomotives is, at any rate, a fair one. In the case of the North-Eastern Railway, it can be shown, as mentioned above, that the cost of coal and water on the locomotive will balance the cost of the power delivered, including all the expenses before mentioned.

The additional saving of 40 per cent. on the Chicago, Milwaukee, and St. Paul Railway, is due to the fact that the power supply is almost entirely generated in hydro-electric stations, consequently reducing the cost of the power delivered to the locomotives. Even though these costs for the N.E. Railway balance, the advantages gained by electric motive power increasing gross earnings; and decreasing operating and maintenance expenses, are sufficient to guarantee the adoption of electrification.

Wherever it may be necessary to have recourse to double heading, this can be more easily and satisfactorily done with electric than with steam engines; for two electric engines can be readily coupled electrically by a low voltage control cable and when this is done the two locomotives can be operated by one crew, precisely as if they were one locomotive, in a similar manner to the operation of the various motor-coaches on a multiple unit train by one motorman. Double heading with steam engines cannot be worked with only one crew, and is subject to the difficulty of synchronising the various operations. Again, so far as the comfort of the crew is concerned, the electric locomotive is superior to the steam engine. Owing to the more even torque exerted by the motors, electric locomotives ride more smoothly than steam engines. The cab, too, may be completely closed and fitted with electric heaters, which enables a comfortable temperature to be readily maintained.

In very cold weather the electric locomotive has another advantage, in that it is not subject to the effects of radiation and freezing, as is the steam engine; while in hot weather the dangers of starting fires in the dry vegetation alongside the track by cinders falling from the engine, is non-existent. The cost of compensation to owners located along the route

of a railway in this country, due to fires caused by the hot ashes discharged from the uptake of a steam locomotive is considerable, particularly during a period of drought. Again, the entire absence of smoke and dirt from the electric locomotive may be a decisive advantage in certain classes of terminal lines, or where there are numerous or long tunnels to be traversed.

I have endeavoured to show the great advantage of being able to build a locomotive which, by its tractive effort, is able to keep a more uniform speed over the railway. An electric locomotive capable of exerting a pull of 15 tons which would haul a train of 1,000 tons up a gradient of 1 in 100 at 30 miles per hour is within our present load gauge and the corresponding steam unit considerably outside. It would require three of our two-cylinder 0-8-0 locomotives to do the work of this electric locomotive.

The freight locomotives on the North-Eastern Railway were designed and built at the Locomotive Works, Darlington; they are arranged to haul trains weighing 1,400 tons at a speed of not less than 25 miles per hour on the level. They may be described as articulated truck locomotives in which the tractive effort is transmitted through the truck frames.

The motor equipment of each locomotive consists of four totally-enclosed motors, each driving an axle through single-reduction twin gearing. The motors are suspended by means of a cross-beam suspension bar with bearings and reaction springs. These, with the motor suspension bearings on the axle, provide the motors with four points of suspension.

The four main motors are fitted two in each bogie, and are wound for 750 volts each, the pair of motors in each bogie being connected permanently in series. The four main motors of each locomotive thus form two units, which are controlled on the usual series-parallel system. Each motor is capable of developing 275 brake horse-power at a speed of 20 miles for one hour with forced ventilation. The motor equipment is capable without injury of exerting a torque sufficient to skid the wheels on any conditions of rail, and will exert an average pull of 28,000 lb. at the tread of the wheels when starting under normal conditions of rail. The maximum pull at the tread of the wheels is considerably greater.

The driving wheels are eight in number, measuring 4 ft. in diameter; wheel arrangement, 0-4+4-0; length of fixed wheel base, 8 ft. 9 in. per truck; total of both trucks, 27 ft. There are four axles, and the total weight is 75 tons. The horse-power of the motor for one-hour rating is 275, and for continuous rating, 182 h.p.

This design of locomotive appears to be generally suitable for dealing with goods and mineral traffic up to the necessary speed.

The latest type of heavy mineral and goods steam locomotive built on the North-Eastern Railway in 1919, usually known as the 0-8-0 class, is a three-cylinder engine with 200 lb. boiler pressure. It has a maximum tractive effort at 85 per cent. boiler pressure of 41,070 lb. Weight on coupled wheels, 71 tons 12 cwt. Total weight ready for running, 115 tons 14 cwt. In trials carried out on the North British Railway a load of 755 tons was hauled up a gradient of 1 in 75 at an average speed of 2.81 miles an hour, over a distance of 7 miles.

Trials between this engine and the electric engine were carried out on the Shildon and Newport line; the heaviest gradient was 1 in 103, and the total weight hauled in each case was 1,003 tons. The length of run was 17¼ miles.

Tests were arranged with a dynamometer car attached to the load, as follows:—

1st. A through run without a stop.

2nd. Three stops at the bottom of the heaviest gradients.

3rd. Three stops with the whole train up on the heaviest gradient.

The results are shown as under:—

	Steam.	Electric.	Average Draw Bar Horse Power. Steam.	Electric.
1st Test (time) ...	56½ minutes	54	862	870
2nd ,, ,, ...	77 ,,	53	602	883
3rd ,, ,, ...	66 ,,	66	682	716

The two locomotives were designed to be of equal strength. From the tests it will be seen that the electric engine handled the load better than the steam; there was less time taken. The steam engine was not able to maintain itself, owing to the fact that it was not able to keep up steam. The fire had to be cleaned out after the second trip, consequently terminal time was wasted. The electric engine, after completing the three trips, could have gone on doing this work indefinitely.

The North-Eastern Railway has also designed an electric passenger engine, which is being built and erected in its locomotive works at Darlington, the electrical equipment being provided by the Metropolitan-Vickers Electrical Co. This engine is arranged to haul a 450-ton express passenger train at an average speed of 65 miles per hour.

The running gear is designed for a maximum safe speed of 90 miles per hour, without doing damage to the mechanical portion of the locomotive, which is of the 4-6-4 type (fig. 1), and consists of main frames mounted on three driving axles with three pairs of driving wheels 6 ft 8 in. in diameter, and a four-wheel bogie at each end; the cab and sloping ends are rigidly fixed to the main frames, and are provided with the necessary supporting members for carrying the auxilary and control equipment. The current is collected from the overhead trolley by means of pantagraphs mounted on the roof at each end of the centre compartment.

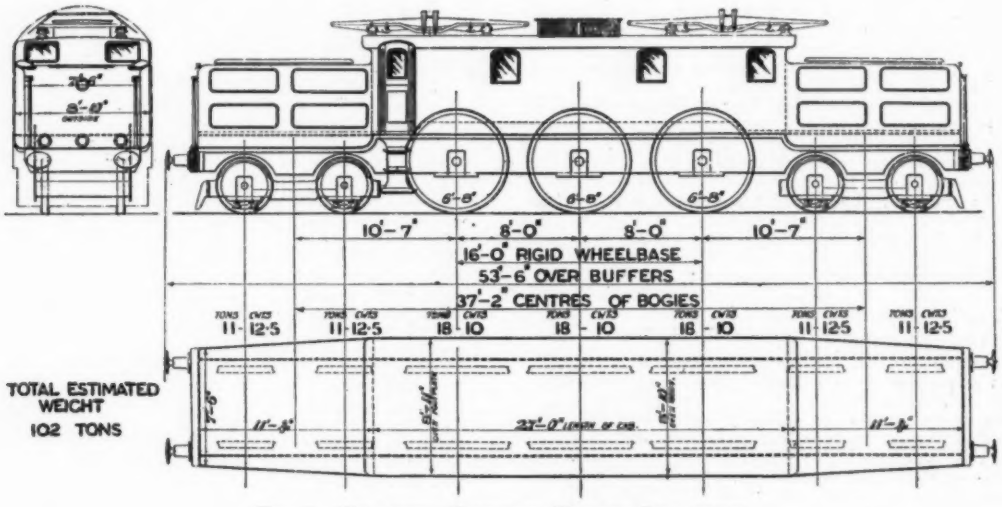


FIG. 1.—HIGH-SPEED PASSENGER ELECTRIC LOCOMOTIVE.

The main traction motors, which are of the twin armature type, are rigidly fixed to the main frame of the locomotive, and transmit the torque to a gear wheel mounted on a hollow shaft or quill drive. The high-pressure apparatus is located in one of the sloping ends; the other sloping end contains an electric boiler for supplying steam for train heating. The capacity of the locomotive will be 1,800 horse-power, one-hour rating, or 1,260 horse-power continuous rating.

The Shildon and Newport section of the North-Eastern Railway is operated with d.c. at a line voltage of 1,500 volts. Three-phase energy is received from the power company's system at 20,000 and 11,000 volts at the Aycliffe and Erimus rotary converter sub-stations respectively, where it is converted to direct current at 1,500 volts, and fed to the overhead track equipment.

The sub-station at Aycliffe contains two 800-kW rotary sets, each set consisting of two 400-kW rotary converters connected in series. At the Erimus sub-station two rotary sets are installed, but in this case one of the sets is of 1,200 kW capacity.

With respect to sub-stations generally, the latest development with regard to these, which I saw in practice in the States, is that they can be worked automatically. Each automatic sub-station contains a single rotary converter, together with the necessary alternating-current transformer and switchgear and direct-current switchgear, and the various relays and other small devices for automatic control. The rotary converter starts up when it is required, and shuts down when it is not required, thereby reducing the time of idle running and cutting out the losses that would occur during that time. The arrangement of the automatic mechanism in conjunction with the switchgear provides for the following cycle of events:—

If a train or a single car is approaching the sub-station this will be indicated by a fall of pressure on the overhead line which is connected to the direct-current busbar of the sub-station. As soon as this fall of pressure reaches a certain value, for instance, as soon as the pressure falls to 75 per cent. of its normal full value, a relay closes which starts a succession of movements of various switches, having the effect of starting up the rotary converter in exactly the same way as it would be started by an attendant. The rotary converter is up to speed in about 35 or 40 seconds, and it is then connected to the overhead line and takes its share in supplying power to the train which is approaching. So long as the train is taking power from the sub-station the rotary converter is kept running. When the train passes out of the section fed by the sub-station, or when for any cause the train ceases to take current, another relay in the sub-station comes into operation and sets in motion a mechanism which is so arranged that after a definite interval of say 4 or 5 minutes the rotary converter is shut down if, in the interval, no further supply is required. This delayed action is necessary to prevent the converter being shut down too frequently, for example, whenever the power is switched off the train for a halt at an intermediate station. The rotary converter having been shut down can then be started up again in precisely the same way as soon as another train approaches the sub-station.

In addition to the various movements, &c., necessary for carrying out this programme, other protective devices are provided which guard against damage to the rotary converter under abnormal circumstances, such as short circuits on the line, overheating of the windings, or of the bearings in the rotary converter, &c.

Thus, the sub-station attendant is entirely eliminated, and as, in many instances, sub-stations have to be in service for more than 16 hours a day, the introduction of automatic working eliminates the three shifts of attendants. All that is necessary is that the sub-station as a whole, including the automatic relays, should be inspected at regular intervals.

I went very carefully while I was in the States into the question of the cost of running sub-stations. This cost is generally expressed in so many pence per unit sent out from the sub-stations and the figure naturally depends upon the capacity of the sub-station, as it costs almost as much for an attendant to look after a small as a large plant. On the Chicago, Milwaukee and St. Paul Railway, where the sub-station plant is of considerable magnitude, the total cost of (including attendants) maintenance and supervision, worked out at only .048d. per unit delivered. Of this total the cost of attendants alone is .0315d., which shows that this is the principal item in the total cost. If the sub-stations were worked automatically—which is more than a possibility, as the method seems now thoroughly well established in the States—the total cost of running the sub-station on that line would not be more than about .02d. per unit delivered.

I would therefore submit that it has been shown that the use of electric locomotives on railways shows many and great advantages.

It is generally known that other countries have extended in the way of electric traction, far ahead of this country, probably on account of cheaper methods of generating electric power; but I see no reason why electricity should not be generated by the use of waste heat, and methods of this description, with such economy as to enable us to compete with electricity generated by water power abroad.

I should like to emphasise very particularly the question of cheap generation of electric power, as this is one of the governing factors in promoting electric traction on railways.

I believe that supply companies should be able to generate this power much cheaper than a railway company, as they ought to be able, generally, to get a much better load factor; and the desire should be that electrical energy will be produced at such a cost as to ensure that the price for energy, plus the maintenance of the railway equipment, shall not exceed the present coal and water bill. If this is done, undoubtedly electrification should proceed rapidly.

DISCUSSION.

SIR CHARLES PARSONS, K.C.B., F.R.S., opening the discussion, said that Sir Vincent Raven had been amongst the pioneers in the introduction of electric traction, and they must agree that he had proved the case for the new system, on heavy load lines, at all events. The steam locomotive had only half the economy of the steam engine of the same size in a land station, on acocunt of the difference in the economy of the boilers. Furthermore, a large percentage of the coal was blown up the chimney by the violence of the draught. The only question that could arise with regard to the enormous advantages of generating power on a large scale in a fixed station was loss in transmission, and the capital cost of transmission, and Sir Vincent Raven had given them data that should entirely set their minds at rest on that question. In America they had a great deal more water power than we had, but water power was in fixed localities, whilst large generating stations could be erected where they chose. The cost of transmission was greater than was generally supposed, and therefore water-power stations might not be as advantageous as appeared at first sight. In this country the generating stations could generate electricity quite as cheaply, if not more cheaply, than could be done in the United States.

MR. H. A. WATSON, General Superintendent, North Eastern Railway Company, said he was in entire agreement with Sir Vincent Raven as to the advantages of electricity for the operation of railways. As was well known, the North Eastern Railway Company had a scheme for electrification at present under the consideration of the directors; personally, he would be the better pleased the sooner that scheme was carried into complete effect. As an officer of the company who was more specially responsible for the handling of the traffic he believed the adoption of electric traction would be beneficial, not only to the North-Eastern Railway Company, but also to its customers. It was quite clear, in his opinion, from investigations which had been made at a great expenditure of time and trouble, that the movement of the traffic would be a great deal more rapid and comfortable. Mr. Watson also argued that the electrification of railways would cheapen the price of electricity, basing the argument upon the fact that when the electrification of the Tyneside passenger lines was brought about, in 1904, the effect of the decision of the North-Eastern Railway Company not to generate electricity, but to purchase it from the supply company already operating in the district, enabled that company to reduce its charges all round.

MR. ROGER T. SMITH, Electrical Engineer of the Great Western Railway, said the result of the comparison of the steam and electric locomotives was a handsome balance in favour of the electric locomotive. What that balance was exactly, must be decided, and each railway would have to determine each particular case according to the circumstances before it decided upon electrification, because they had not got to the stage when any generalisation was possible or advisable, but pooling was essential if they were to reap the advantage of electric locomotives. He thought that with the present high price of coal the North-Eastern Railway would still be on the right side by 30 or 40 per cent. He hoped that at an early date the North-Eastern Railway would carry out its main-line electrification which was contemplated between Newcastle and York, as the North-East Coast Co. to-day was able to supply cheap electricity because it was one of the pioneers among the companies which installed generating stations with large turbines. With that cheap supply the economies shown in replacing steam by electricity were such that that section should be a very profitable one to electrify.

MR. F. LEIGH MARTINEAU, of the "Still" Engine Co., raised the question whether they could take advantage of the economies of internal-combustion engines, and in that way overcome the difficulties on those lines where the service was not dense enough to warrant the enormous capital expenditure for electrification.

MR. J. DALZIEL, of the Midland Railway Co., said it had been shown that they could make a saving, but it had not, so far as he could see, been proved that it would be a sufficient saving to show a satisfactory financial result. For instance, what was the position on a heavy graded line?

MAJOR S. G. RODMAN said that those whose business it was to deal with electric traction knew its advantages, and Sir Vincent in his paper went straight to the point to prove this.

SIR VINCENT RAVEN, in a brief reply, referring to internal-combustion engines, agreed that the advantages which he had suggested, and which had been proved, were not advantages that could be applied generally, and the question of transforming traction from steam to electric must be one of degree, and not as a whole. There was no doubt that there was an opening for improvement in railway traction outside the question of electric traction. The steam locomotive had done well for one hundred years, but it would, in a reasonable time, be supplanted.

BREAKDOWN OF A 30,000-KW TURBINE.*

On September 3rd a 30,000-kW turbine in the Schuylkill plant of the Philadelphia Electric Co. had just been taken off the bus-bars, and, following the regular practice of testing the overspeed mechanism weekly, had been gradually brought above its normal speed of 1,500 r.p.m. until the automatic governor operated at 9 per cent. overspeed, when the throttle closed and the machine began to slow down. A few seconds after the main throttle had closed, shutting off the steam to the unit, a loud hissing noise was heard, instantly followed by two heavy crashes and a shower of broken pieces of metal, including the exciter armature with the end of the mainshaft. Fortunately there were no serious injuries to any of the employés in the plant, and comparatively little damage was done to the building or other equipment.

Messrs. H. F. Moore, professor of engineering materials, University of Illinois, and George L. Kelley, metallurgist, of Philadelphia, were retained by the Philadelphia Electric Co. to investigate the cause of the failure, and it is from their reports that the present article is compiled.

The low-pressure casing was cracked and the steam passages from the high to the low-pressure stages were broken. Two pieces were broken out of one of the disks in the low-pressure stages, as shown in figs. 1 and 2. All the shaft

* From *Power*. Abstract.

bearings were broken, and the 20-in. mainshaft was broken off short between the bearing A, fig. 2, and the generator. Other fractures were apparently due to flying particles. The broken wheel was approximately 9 ft. in diameter, and the pieces broken out were about 5 ft. long, ranging in width up to 22 in., and occurred about 38 in. apart on the periphery.

One of the most striking features of the wreck was the breaking of the mainshaft and the tearing up of the surface of the exciter armature. The evidence seems, to Professor Moore, to show that the failure of the main shaft was one of the last events in the wreck. "When the shaft failed," he says, "the main generator field was left as a weight of about 50 tons overhanging the bearing B in fig. 2, which is a diagram of the turbo-generator rotor. This heavy overhung weight was badly out of centre, therefore it would seem highly probable that if, under these conditions, rotation was kept up even for a few seconds, this heavy eccentric weight would be thrown against the armature windings of the generator, tearing them loose. Except at one end, where the blades of a small ventilating fan stripped off some insulation, the generator armature windings are uninjured. It seems to the writer that the breaking of the main shaft must have been about the *last* event in the wreck."

Still quoting Professor Moore, both fractures in the turbine disk showed evidence of a progressive fracture originating in a deep tool mark and extending almost through the thickness of the disk, together with a final sudden fracture resulting from the sudden tearing out of fragments A and B (fig. 1) from the disk after it had been sufficiently weakened by the spread of the progressive fracture. The cause of such a fracture must be sought in the existence of lateral vibrations in the disk. The steam jet enters on one side of the buckets and leaves from the opposite side, any frictional lateral drag from the steam is all in one direction, and as the disk revolves the steam must strike on any given blade with a regular

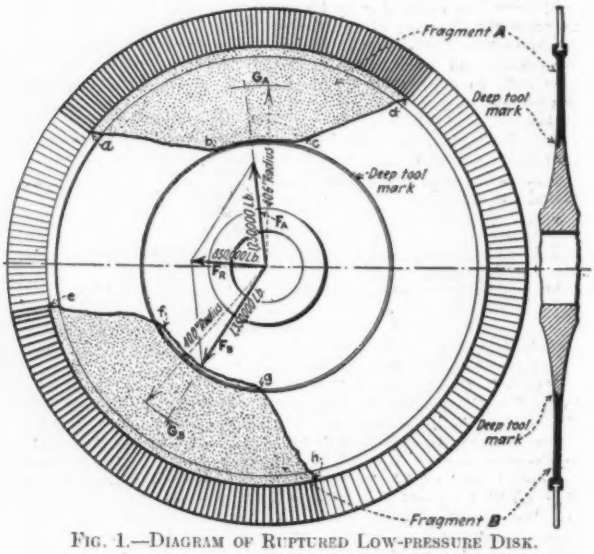


FIG. 1.—DIAGRAM OF RUPTURED LOW-PRESSURE DISK.

rhythmical variation of force. At certain speeds this rhythmical variation might be so nearly "in tune" with a natural period of lateral vibration for the disk that severe repeated bending stresses would be set up. If such a critical speed existed between a state of rest and the normal speed of the turbine, the disk would pass through a brief period of severe sidewise bending stress every time the turbine was started, and perhaps every time it was stopped. If for a period of one second the turbine speed was sufficiently near the critical speed to cause severe lateral vibration, it would be subjected to, perhaps, 100 severe lateral stresses. The turbine was usually stopped and started every two days, and had been in service for about seven years. It seems probable that the disk may have been subjected to as many as 100,000 repetitions of severe lateral vibration—a sufficient number to develop such a typical progressive fracture as was shown.

It may be noted that probably any dangerous lateral vibration in the disk was a rather complex process. If the disk in sidewise vibration took a simple sidewise curve the blades of the turbine would hit the nozzles, or the edge of the disk would hit a diaphragm, before sufficient deflection took place to set up serious bending stresses, or, to put it in another way, with a one-lobe vibration, the radius of curvature of the bent centre line of the disk would be large and the fibre stress low. If, however, the disk vibrated in several "lobes," a considerable fibre stress could be set up with a small lateral vibration of the edge of the disk.

The rough surface finish and the deep tool mark previously noted doubtless served to localise fracture due to any sidewise vibration. Judging from recent tests at the University of Illinois, made in the course of the Joint Investigation of the Fatigue of Metals, such surface conditions might reduce the ability of the disk to resist lateral vibration by as much as 20 per cent.

A progressive fracture having started, it might be expected to spread until the disk was so weakened that, under the steady centrifugal force due to rotation, a fragment would suddenly tear itself loose, the final failure being a sudden shearing or tearing of the metal not destroyed by progressive failure.

The weights of the fragments (fig. 1) were found to be 410 lb. for fragment A and 455 lb. for fragment B. The distance from the axis of the main shaft to the centres of gravity of the fragments was found to be 3.39 ft. for fragment A and 4.33 ft. for fragment B, which, at the normal speed of 1,500 r.p.m., would give a centrifugal force to the fragment A of 1,240,000 lb., and to the fragment B of 1,350,000 lb.

If the primary cause of the wreck was a progressive failure in the turbine disk, then, when that progressive failure had gone far enough to allow the centrifugal force to tear out a fragment, the metal from *f* to *g* (fig. 1) was cracked nearly through the disk. For fragment B the lines of final failure are nearly radial, and an approximate idea of the average stress set up may be obtained by dividing the centrifugal force by the area of the metal along *ef* and *gh*. This area, by measurement of careful sketches made from measurements of the fragment is about 36 sq. in. and the average shearing stress is 1,350,000/36=37,400 pounds per square inch.

By analogy with the distribution of shearing stress in beams, the shearing stress at the middle of the fracture may be expected to be not less than 50 per cent. in excess of the average, or 56,000 lb. per sq. in. This is well above the yield point in shear for 3.5 per cent. nickel steel, and, in view of the probable irregularity of stress distribution over the fracture, is believed to indicate a stress sufficiently high to tear out the fragment.

If the primary cause were a progressive failure in the disk, then the wreck might be expected to occur at one of the regular periods of high speed. When, in order to try out the automatic stop, the speed was increased to 109 per cent. of its normal magnitude, the centrifugal force was increased to 1.19 times its normal value. This is a very material increase in the stress, and would seem to indicate that if a turbine is ever in danger of wreck from a progressive failure in a disk, it is at the time when, for any reason, the speed is increased.

If the primary failure was in the turbine disk, then the other failures can readily be explained. The first effect of the primary break might well be to crack the casing, which would allow an inrush of air into the vacuum within the casing, and would cause the loud hissing noise noticed during the wreck. The flying-off of the fragments would batter and tear nozzles and diaphragms, and would throw the pieces against the walls of the steam passages, fracturing those

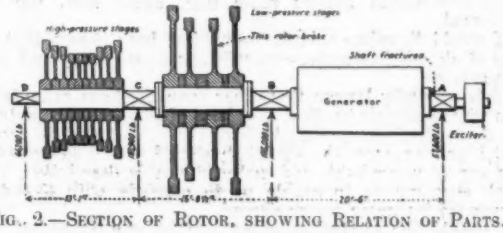


FIG. 2.—SECTION OF ROTOR, SHOWING RELATION OF PARTS.

walls. If fragment B broke out first, then the rotating parts would be unbalanced by 1,350,000 lb., and after both fragments broke off, the unbalanced forces would be the resultant of the centrifugal forces of the two fragments, which resultant is graphically determined in fig. 1, and found to be 850,000 lb. That is, there would be a lateral force of from 850,000 lb. to 1,350,000 lb. acting on the shaft. Any exact computations for secondary events are quite out of the question, the action being complicated by the interference of broken fragments, the inertia and the gyroscopic action of heavy rotating masses, and the magnetic forces of the field of the generator. In a general way Mr. Moore pictures the course of events as follows: The enormous lateral force first broke bearing B (fig. 2) downward. This failure caused the rotating field to run out of true and the exciter end of the main shaft to bend near bearing A, which is spherical-seated. This jammed the exciter armature into the polepieces, bending and breaking off the shaft and throwing it to one side, together with pieces of the exciter frame and bearing A. This apparently stopped the rotation of the shaft, disks, and generator field. During this action there was sufficient racking action on the shaft to break up bearing C badly and bearing D slightly. There seemed to be a general tendency for the rotating parts to move toward the exciter end of the generator.

Referring to the disk, Dr. Kelley says: "These fractures were on the portion of the bucket wheel that was still in place on the shaft. Immediately below the rim, and for some inches beyond, evidences of dendritic structure were clearly discernible. This indicates that the wheel was probably made from cast steel in distinction to forged steel. It also indicates that the original cast structure had not been effectively destroyed by heat treatment. As the centre of the wheel is

approached the dendritic structure disappears, and for a length of about 25 in. both fractures present a very smooth surface, having the characteristics of hard metal. Two test pieces were taken in a tangential direction from one of the large fragments at distances of 13 and 20 in. from the periphery of the wheel. The latter position is within about one inch of the metal, which appears hard. The test results indicate that there is no difference in hardness in the two positions. This smooth fracture somewhat suggests the appearance of a detailed or progressive fracture, but no evidence of the rubbing of crystals was noted, nor could any flaw be located which could have initiated the fracture. It seems improbable that these are progressive fractures because of the large area and because there are two similar fractures on opposite sides of the wheel."

In Dr. Kelley's discussion of the cause of the failure he suggests that the failure of a bucket followed by jamming between the wheel and the casing may have been a cause, or the bucket wheel may have broken. No evidence of failure was noted which could be attributed either to the quality of metal used or to the method of machining. Present practice involves the use of forged steel instead of cast steel, and all are heat-treated by quenching and drawing instead of by annealing. This process gives a bucket wheel having moderately high physical properties, and one that it much less subject to failure from fatigue stresses.

"It is now the practice of the General Electric Co. to specify that turbine bucket wheels for all the larger turbines and many of the smaller ones shall be forged and then heat-treated by annealing, quenching, and drawing. A second quenching is used by some manufacturers, and possibly by all. The likelihood that this would have a beneficial effect on the structure of the steel would, in my opinion, justify its specification in all cases. I believe the use of cast turbine bucket wheels has been abandoned. Because of the shape of these wheels some security would be gained if all bucket wheels were tested at more than two points to ensure uniformity in properties. The General Electric Co. has had such a plan under consideration, and at present may have it in use.

In design, abrupt changes of section and the formation of sharp angles in bucket wheels should be avoided as far as possible. The design of the rim still offers opportunity for improvement in this respect. I have reference to sharp angles in the groove.

As to the selection of material to be used, physical properties required and method of heat treatment, no better practice than the present one occurs to me. As suggested above, a more rigorous testing may be justified.

I am aware that the General Electric Co. has taken pains to leave machined surfaces free from sharp corners. It is important that this caution be maintained, for such points may serve as a locus of weakness resulting in fracture."

An editorial comment states that a subsequent examination of the diaphragms brought out a point not mentioned in either of the reports; that is, that the diaphragm next to the wheel that failed had been rubbed by the bucket shroud band, the indentation due to the wear of the band in the diaphragm being as much as one-eighth of an inch around the entire periphery. The turbine engineers of the General Electric Co. feel that in all probability this is the exciting cause for the axial vibration referred to by Professor Moore, and that it probably occurred from time to time when the machine was being put into service, and before the entire structure became uniformly heated.

THE CANADIAN MARKET.

Some of its Difficulties.

THERE is a hint at an apology in the foreword of Capt. E. J. Edwards's report on the conditions and prospects of British trade in Canada, which has recently been issued by the Department of Overseas Trade. (H.M. Stationery Office 2s. 3d.)

His idea in preparing his report has been to devote his attention to the present and the future, and only to refer to the past in order to show the importance of the market for various commodities. Criticism will, Capt. Edwards expects, be levelled at him for dealing with certain comparatively unimportant trades, and too little with the important.

His reasons for this course are, however, quite sound. As he points out, manufacturers of many staple lines possess an adequate and practical knowledge of conditions and prospects in their own particular trade. Therefore the report deals mainly with lines of goods which are being brought almost entirely from foreign countries.

Capt. Edwards's enthusiasm over the possibilities of selling various British lines in Canada will, it is feared, not be wholly shared by electrical manufacturers here. It is to be hoped, however, that his confidence may inspire them to renewed effort.

American Standards.

There is little need to emphasise the powerful part taken by electricity in Canada, due to the wealth of cheap energy produced from its prolific water-power. As has been reported frequently in these columns, the British manufacturer is confronted with a difficult task in overcoming the Dominion's predilection for American standards—with which his products do not always conform—and the competition of both United States and Canadian manufacturers. The advantage possessed by these competitors in the matter of freight rates, is less marked in Western Canada than it is in Ontario. It is to be hoped that in the former territory, at any rate, the old country may succeed in obtaining a good proportion of the important telephone contracts which are pending.

Capt. Edwards's opinion which, he says, is shared by all who have a knowledge of trade conditions in Canada, is that now is the crucial time for manufacturers from the United Kingdom to regain or obtain trade. In his view the Canadian Government and people have shown in a marked and tangible way their desire to encourage imports from the United Kingdom rather than from the United States, for not only does the former enjoy preferential tariffs, but owing to the recent enactments, the Dominion will in effect be giving a further preference, so long as the Canadian dollar is appreciated in relation to sterling and depreciated in terms of American currency, by calculating Customs duty on the Canadian value of goods imported at the current rate of exchange.

Attention is drawn by Capt. Edwards to the educational institutions of the Dominion for which much additional building and equipment is planned. United States manufacturers and publishers realise the importance of impressing the coming generation of professional and business men and women. The result of this is found in the laboratories, engineering shops, scientific research departments, and other sections of educational institutions. For example, those universities which have a course in agriculture, have a standard exhibit of all classes of agricultural implements and machinery, and not only are students instructed in their mechanism, but they have opportunities of putting them into practical use. These exhibits are loaned free of charge and carriage paid to the universities by the various makers, and immediately a new model is introduced, it is substituted for that already exhibited. The suggestion is that British manufacturers should follow this example.

Agency Questions.

On the subject of agents, the report refers to the necessity for having more than one representative in Canada.

Except in very special cases a United Kingdom manufacturer cannot obtain the best results from the Canadian market unless he has the Dominion divided into three or four territories with a representative in each.

Although a certain number of manufacturers in the United Kingdom still hold to the method of combining Canada and the United States in one agency, and of letting the agent in the latter work both countries, it is satisfactory to learn that this method is on the wane. Many of such arrangements date back to the period when the population and purchasing power of Canada were small compared with the present. For many reasons the method is now undesirable. Distance impedes its success. The strenuous competition of these days is another reason against the method, and the sentiment of the Canadians is also against it. They do not see why any of their money should go to United States agents who spend little in the Dominion, when there are many reputable firms and individuals in all classes of trade who are Canadians and fully competent to represent adequately United Kingdom manufacturers.

Engineering and Machinery.

During the year ending March 31st, 1921, the total machinery imported into Canada, excluding agricultural, amounted in value to $44,642,000, of which no less than $40,767,000 represented importations from the United States, while the United Kingdom was responsible only for $3,546,000. Although the last-mentioned figures are more than double those of the preceding year they are, as Capt. Edwards says, anything but satisfactory, especially as during that period United States trade increased by six and a half million dollars.

At the time of writing, he adds, few orders are being placed for machinery, and there is little likelihood of any improvement in the immediate future. This is brought about by the period of depression through which Canada, in common with the rest of the world, is passing, and also because buyers are hoping that prices will still further decline. It is impossible to write in detail regarding the prospects for all the various classes of machinery, so he confines himself to general remarks which may be applicable to all. "In the majority of cases tenders and delivery are required in a hurry. For instance, a town may have been perfectly contented with its existing water supply until at one meeting of the council it is proposed and carried that a new plant be installed. Tenders are called for immediately and the question of delivery is a predominant factor. Naturally, United States engineering firms benefit by

this Canadian characteristic, and this brings me to my second point. There is seldom sufficient time for blue prints or specifications to be obtained and sent home so that United Kingdom manufacturers may tender. Consequently adequate local representation is essential, either by branch houses or by agents. I use the word 'adequate' purposely, for I consider it imperative that the agents should be really technical men with an expert knowledge of the various types of machinery which they are trying to sell and the uses to which these are put. They should be so qualified that where there is not sufficient time to mail particulars to their United Kingdom principals, they are able to put the salient points succinctly in a cable. I would urge United Kingdom engineering firms when replying to a Canadian inquiry to remember the proximity of the United States, and therefore to quote their very lowest prices, and to give the most forward delivery date possible, which must be rigidly adhered to should the order eventuate." Capt. Edwards says it would certainly be of benefit if H.M. Trade Commissioners in Canada were kept supplied with illustrative and descriptive catalogues of all classes of machinery and engineering work. "Only this week a visitor to my office stated that he would have to order certain equipment from the United States because he felt sure that no firm in the United Kingdom could produce the exact type he wished. I told him the names of three makers who, I believed, could satisfy his requirements, and offered to cable, but he informed me that this would take up too much time and it would be difficult to give sufficient details by wire. By an extraordinary coincidence, on the same day a well-illustrated catalogue arrived from one of the three firms which I had mentioned, and in it was depicted exactly the class and type of machine for which the inquiry called."

INDUCTION-TYPE SYNCHRONOUS MOTORS.

By L. H. A. CARR, M.Sc. (Tech.), M.I.E.E.

(*Abstract of Paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE importance of power factor correction is so well realised that it is unnecessary to labour the point, but, owing to the high capital costs now involved, it is more than ever necessary to utilise existing cables to the fullest extent by making them carry a current as nearly as possible in phase with the pressure. The induction-type synchronous motor or synchronous induction motor has been developed to produce a motor which, while retaining the advantages of a synchronous motor as regards its property of power-factor correction, possesses the good starting characteristics of the slip-ring induction motor. It consists essentially of an induction motor coupled to a d.c. exciter. It is started up as an induction motor and, when the exciting current is switched on, it synchronises itself and then continues to run as a synchronous machine.

The secondary may carry, in addition to the "power current," a part or the whole of the magnetising current, and possibly even an over-magnetising current which will give a leading component to the primary current. The secondary current is controlled by external means, and does not increase automatically when an overload is applied. Hence the normal full-load excitation of a synchronous machine must be large enough to allow for a reasonable overload capacity.

The economical method is to run the motor normally at a leading power factor of about 0.9, and thus utilise the extra excitation to correct the power factor of other parts of the system. In the majority of cases there will be little difference

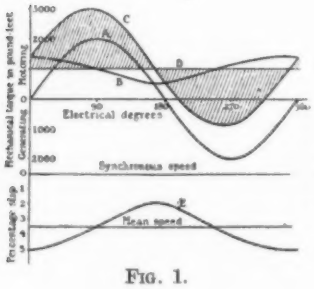


FIG. 1.

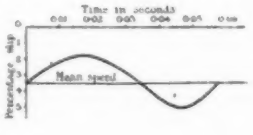


FIG. 2.

in first cost between a synchronous induction motor arranged for unity and one for 0.9 leading power factor, since, in order to allow for the necessary overload capacity, the same exciting member has to be used in each case.

The principal advantage which the synchronous induction motor possesses over the plain synchronous motor lies in its starting characteristic. It starts up from rest like an induction motor and easily synchronises itself almost instantaneously against full or more than full load. Compared with the corrected induction motor, *i.e.*, the induction motor fitted with a phase advancer or vibrator, the synchronous induction motor possesses the following advantages:—(*a*) It may be corrected not merely to unity, but to a leading power factor, for which it is even more suitable. (*b*) It delivers a leading component of current down to no load; in fact, this component increases slightly as the load decreases. (*c*) The action of a phase advancer is to increase the slip. The synchronous induction motor, on the other hand, runs at constant speed; it has zero slip. (*d*) The commutator, which it appears must be introduced into all machines that act as correctors of power factor, commutates low-voltage direct current.

Two slightly different types of synchronous induction motor are at present manufactured in this country, but in both the stator is a standard induction-motor stator. In the one type the rotor is always of the three-phase type. Although when excited by d.c. one-phase carries twice as much current as either of the other two, it is usual to make all the conductors of the same size. When running synchronously this three-phase winding has an exceedingly good damping effect. In the other type, the main rotor winding consists of concentric coils of flat copper ribbon wound in open slots, covering about two-thirds of the rotor periphery. This is frequently the only winding, the rotor thus being single-phase (in which case the centre of the pole is left unslotted). Occasionally the remaining third of the rotor periphery is wound with a second phase of reduced cross-section for starting, this winding being short-circuited to act as a damper winding when the machine is running at full speed. In both types each motor has its own exciter.

The starting presents no difficulty, since the self-synchronising feature of these machines is their only unusual characteristic, and it is important that the large torque which they can exert while synchronising should be fully realised. After the machine has attained its full induction-motor speed with all external resistance in the rotor circuit short-circuited, then (in order to synchronise) the rotor circuit is momentarily opened and closed again so as to include the exciter in circuit. For a short period after this switch is closed the rotor carries both the induced a.c. and the forced d.c. The final action of these two currents is to cause the machine automatically to accelerate still further, and in normal operation synchronous speed is reached in a fraction of a second, the machine then settling down to run as a normal synchronous motor.

The principles underlying this operation may be more easily followed if the case where the machine is unable for some reason or other to synchronise itself be first considered.

When d.c. is switched on to the rotor the machine will develop a torque as a synchronous machine, and as the rotor slips back through a pole-pitch (relatively to the synchronously

FIG. 3.

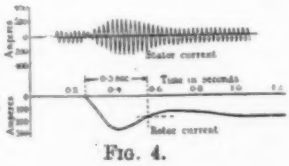


FIG. 4.

rotating field) this torque is alternately motoring and generating and causes a fluctuation in speed. Since the machine is running below synchronous speed there will exist in the rotor, superposed on the d.c., an induced a.c. which will vary not only with time, but with the speed of the rotor. This current will produce a varying torque which must be added to the synchronous torque to obtain the total torque. The torques acting on the rotor as it moves back relatively to the synchronous field are shown in fig. 1.

With a cylindrical rotor, neglecting minor corrections, the synchronous torque is represented by a sine wave (curve A). The fluctuating induction torque is represented by curve B, and the sum of A and B gives the total motoring torque C. If the load torque, which is constant, is plotted above the datum line D instead of below it, the difference between C and D (shown cross-hatched) gives the torque causing acceleration and deceleration of the moving masses. The variation in speed produced by this torque is shown by curve E, which also represents the slip, to which the induction torque is proportional. The mean speed occurs when the synchronous torque is a maximum, so that only half the positive lobe of the torque curve is available for acceleration above the mean speed. Since the speed is not constant the angle swept out is not proportional to time, and the areas of the torque curves in fig. 1 are not proportional to the work done. In fig. 2 the same speed curve is transferred to a time basis.

The actual stator and rotor currents of a machine which failed to synchronise are shown in fig. 3, and if the machine is to synchronise, the oscillation must be large enough to allow the rotor to swing right up to synchronous speed.

The machine reaches synchronous speed when the angle of lag between the centre of the rotor pole-face and the centre of the synchronously rotating flux wave is greater than 90 electrical degrees. In the steady condition of running as a synchronous motor, however, this angle of lag is less than 90 electrical degrees. The rotor will therefore, due to the excess of synchronous torque over load torque, accelerate still further and creep forward to its stable position, where synchronous torque is equal to load torque, at which it will finally settle after a slight oscillation.

During this creeping forward of the rotor the slip is negative, and hence there will exist in the rotor a small induced current in the reverse direction to that which existed during the actual period of synchronisation, as shown in fig. 4, which was obtained while a machine synchronised itself. There is no serious disturbance on the line, the maximum current being not more than about twice the full-load current, and persisting, in the case of successful synchronisation, for merely a fraction of a second, and, in practice, with normal slips, it is exceedingly rare for a machine to fail to synchronise on the first upward swing.

The critical case in which the machine will only just synchronise is of importance, since this gives the limiting conditions under which synchronisation can be guaranteed. This is represented in figs. 5 and 6, and the curve of speed is asymptotic to the synchronous speed, the machine synchronising after an infinite time with a pole-lag such that the synchronous torque is just equal to the load torque.

The synchronous induction motor can be arranged for any desired pull-out torque, the most economical figure being from 75 to 100 per cent. overload for a machine having a leading power factor of 0.9, and correspondingly higher figures for a power factor of 0.8 or 0.85. The pull-out torque when the machine is running as a synchronous motor may, however, be increased (if a large temporary overload has to be carried) by increasing the excitation above the normal value.

The argument put forward in support of phase advancers, that should any breakdown occur in the exciting circuit, the main motor can still be run as a plain induction motor, holds equally good with the synchronous induction motor.

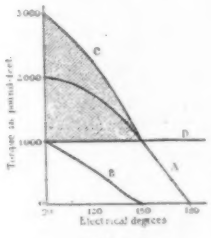


FIG. 5.

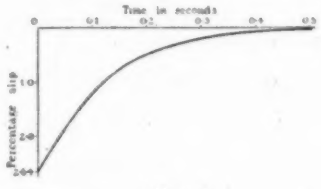


FIG. 6.

It is necessary on synchronous induction motors to keep the excitation voltage low. The relationships between the excitation voltage, excitation current, and the open-circuit voltage of the secondary at standstill follow certain natural laws (beyond the control of the designer).

Thus, with a secondary loss of 3 per cent., an overload capacity of twice full load, and a limiting starting voltage of 2,000 (the figure usually adopted for large machines), the excitation voltage will be 36.6 for a star or single-phase secondary, and 42.3 for a mesh-wound secondary. With larger machines the ratio of excitation volts to excitation amperes becomes unduly low, and it is usual to arrange the secondary winding in two circuits, which are connected in series for excitation purposes. This doubles the excitation voltage and halves the excitation current.

An "inverted" machine, that is to say, to connect the supply to the rotor and use the stator as a secondary or exciting member, has advantages. This construction has already been applied to several machines, and it appears probable that in the future this practice will be extended.

The efficiency of the synchronous induction motor with a leading power factor of 0.9 is usually not more than 1 per cent. below that of the plain induction motor. The increased losses are due to the extra excitation necessary to give the required overload capacity, although this increase is partly offset by the reduced stator loss when the power factor is higher than that of the induction motor. The price of a synchronous induction motor having a power factor of 0.9 is about 25 to 40 per cent. higher than that of a plain induction motor, all accessories, i.e., switchgear, exciter, &c., being included. This figure would, however, probably be considerably exceeded in the case of machines below 100 h.p. The induction motor takes a magnetising component of 48.5 kVA per 100 kW input, while the synchronous induction motor gives out a magnetising component of 48.5 kVA, that is, the advantage of the latter over the former is 97 reactive kVA. To obtain this, the first cost of the machine is increased some 33 per cent., or, roughly, the capital cost per leading kilovolt-ampere is one-third of the capital cost per kilowatt, while, since the extra loss is only 1 per cent., the apparent efficiency of the leading component is of the order of 99 per cent.

On account of the power-factor-correcting duty of the synchronous induction motor, it is most suitable for use in connection with drives where it will be required to run continuously, when, although the load may be varying, the power-factor correction still continues. Many machines of this type have been built in this country during the past few years and have been successfully applied to a number of different duties. Below 80 or 100 h.p. the relatively small amount of leading kilovolt-amperes obtained and the increasing relative cost of the synchronous induction machine render it less popular, although machines as small as 60 h.p. have been put into commercial use. The real field for these machines may be said to be from 150 h.p. upwards. The size to which they can be built appears to be practically unlimited.

DISCUSSION IN LONDON.

DR. S. P. SMITH opened the discussion by congratulating the author on having written what was practically the first paper on the important subject under review. He explained that there were certain great disadvantages connected with the machine described that made the salient-pole machine to be preferred, and as regarded its adoption, much would depend on whether power-factor correction or a large starting torque was required. In France it was the need for correcting power factor that had encouraged the use of the type of machine described. The necessity of a low-voltage commutator was a disadvantage, and in order to obtain a reasonable overload capacity it was questionable whether it would not be preferable to waste excitation by using some of it to drive the flux across a larger air gap. They ought not to lightly forgo the ability to short-circuit slip rings and lift brushes.

MR. H. M. SAYERS remarked that power-factor problems were becoming important, because the 3-phase system of distribution was becoming standard practice in this country, and it was, therefore, good to be told of another way of improving power-factor. The average 33 per cent. increase in cost was a serious point. It rested with the supply authorities to devise tariffs that would induce users to improve the power factor. Another disadvantage of the machine described was the existence of a commutator, however small it was. Not enough use had been made of condensers to improve power factor, and some types of condenser had not even been considered. Why was one of the three phases of the machine made to carry twice as much current as either of the other two? Surely that indicated that either the copper or excitation could be economised, and would it not be preferable to add something to the switchgear, so as to enable the exciting circuit to be made a single-phase one? The title of the paper was somewhat contradictory.

MR. BURNAND compared the machine described with other types, and pointed out that, although it was more expensive and its efficiency and pull-out load were lower than those of a straight-through machine, the former had the advantage of being capable of starting on full load.

MR. AYRES thought that the future of the machine being discussed was and would continue to grow. It must have a reasonable overload capacity, otherwise the "wobble factor" (*i.e.*, tendency to pull in and out of synchronism) became inconvenient, as was the case with machines which were being sold now for which it was claimed that they would start on full-load current at 0.8 load. The author had not been quite fair to phase advancers; even the 33 per cent., stated to be the increase in price of the machine described, was only a comparative figure. In some cases the difference was only 3 per cent.; moreover, the efficiency was not so low as was indicated in the paper.

MR. J. H. JOHNSON was of the opinion that simplicity and reliability were essential if the machine was to compete with those which were at present looked after by unskilled operators. The machine would be welcomed by supply authorities, and (in reply to Dr. Smith) the principal reason for its use would be the improved power factor that would result therefrom. Obviously, a motor that would do that and at the same time was capable of performing useful work had advantages. Regarding the size of motor used, some 50-h.p. 750-r.p.m. machines had proved commercially possible, but the statement that their cost was 33 per cent. above that of the ordinary type was not correct. They would have nothing whatever to fear from the point of view of cost if the power factor correcting properties of the motor were considered.

MR. CHATTERTON SMITH explained that he had gained some useful insight regarding the conditions that obtained inside the machine by means of oscillographs taken during tests on an ordinary motor that was direct coupled to one of the type described in the paper.

MR. W. M. SELVEY said that the author's firm had recently converted an ordinary induction motor into an induction-type synchronous machine, and it had given no trouble whatever, in spite of warnings to the contrary. They had a new weapon to attack the power-factor problem with, which would be very valuable, especially as many existing machines could be converted with little trouble.

MR. L. H. A. CARR, in reply to some of the points raised during the discussion, protested against the machine being

termed a new motor; it had been made commercially for the past twelve years in this country. He thought the feature that was appreciated most was its high starting torque; the title of the paper was poor, he agreed, but there was no better one. He knew of no trouble due to commutation having been experienced, and as both types of machine had their own fields of usefulness neither would prevail. Whether it would benefit the user to pay the extra cost of the machine depended on the tariff on which he was charged for energy. In one case a machine had paid for itself in eighteen months. He had been too severe in some of his statements, and it was true that smaller machines than he had indicated could be successfully installed.

CORRESPONDENCE.

Letters received by us after 5 p.m. on TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Trade Unionism.

I read with considerable surprise your comments concerning Trade Unions, contained in your issue of December 23rd, under the heading "Electricity in Mines." For a paper that has so often advocated Whitley Councils as a means of arbitration, openly to state that trade unions are mainly to blame for the present state of the coal industry, &c., seems somewhat inconsistent.

You refer to economic laws, but what are they? Is there not one law for the employer and another for the employé? Take as an example the recent slump in the coal industry; according to "economic law" the wages of the miner had to be reduced, but not so the royalty received by the landowner, who did not produce the coal, nor even work, but paid an agent to work for him. "Economic law" then reduces the wages of a worker, whilst allowing a non-worker to receive money for minerals produced from the land. This, then, seems to be in favour of the letters written by Dr. Gisbert Kapp and Mr. John E. Grant, in your issues of October 28th and November 11th on "The Principles of Wages Determination."

The trade unions, like many other people (often better educated), have made their mistakes, but if an impartial view is taken of the continual fight throughout history against the diabolical conditions which prevailed in coal mines and factories of years gone by, it must surely be admitted: (1) That the very existence of trade unions is due to these bad conditions. (2) That the worker has always had to fight for his rights, wrongfully denied him by the powers that be, and with all shame to England still has to do so.

May the time speedily come when right (ever the strongest weapon) will win.

Fairplay.

December 26th, 1921.

[Whitley Councils are one thing and political strikes are another; we did not attack trade unionism, but trade-union policy. Trade-union leaders admit that the recent miners' strike was ill-advised and disastrous in its effects; whatever benefits the miners secured by it could have been obtained without any strike at all, and if the Whitley Council system had been in force in the mining industry, there would have been no strike.—EDS. ELEC. REV.]

Removing Lacquer from Lamp Bulbs.

I beg to ask through the medium of your paper if any of your readers know of a good method for removing lacquer from electric lamps. I am working as an operator at a Manchester picture house, and in the ceiling lighting we have two sets, the usual white and red; I am puzzled how to remove the lacquer from the lamps that have faded or are showing white spots. What I wish to do is to remove the old lacquer so as to be able to use them again; I have tried scraping the lacquer off, but in most cases the filament was broken in the process.

T. E. Baldwick.

Manchester,
December 28th, 1921.

A Dynamo that Grew Tired.

I should be very grateful if you would give me an explanation or put forward a theory which would account for the peculiar behaviour of the generator described below:—

The machine is a two-pole, compound-wound dynamo, driven by a single-cylinder steam engine by means of a belt drive. Its duty is to run lighting and motors in a works after the major part of the load has been cut off for the day. The machine is designed to give 220 volts and 120 amperes.

The generator load never exceeded 100 amperes, and this load was carried easily without any sparking or heating. It was found one day on running the machine up and placing it on load, that while the excitation was perfect, the machine would not take the usual load by about 20 amps. without the voltage rapidly falling away, but would continue to run perfectly at, say, 80 amps. After a lapse of three days the machine would not carry a load of more than 40 amps.; still it excited quickly on starting up, and maintained its voltage at 40 amps. Eventually, while the machine still excited as well as ever, the load carried would not exceed about 5 amps. without consequent loss of voltage.

The condition of the machine for insulation was about 1.25 megohms, non-contact practically infinity and continuity was good, commutator clean, and brushes bearing evenly. To remedy this defect the following experiment was tried, and evidently with success, as the machine has now been running for over two months, and is carrying a load of 120 amps. without any trouble:—

1st, reverse polarity of machine and place on a medium load instantly.

2nd, reverse again to original polarity.

The machine then ran with load as before stated.

Puzzled.

December 31st, 1921.

Support for French Industries.

With further reference to my letter to you, which appeared in the October 7th issue of the ELECTRICAL REVIEW, the result has been quite interesting to me, for I have been favoured with letters from a good many French manufacturers, and in some cases have had a visit from their representatives, whom I have been able to help by suggesting names of engineers to call upon and correspond with.

The engineer representing one firm in particular, on a return journey, informed me that he had been extremely well received, and from his conversation I gathered that there is evidently a strong desire to do business with our French friends.

Further, I think if French manufacturers were to appoint a resident local representative for this particular district they would get into quicker personal touch with their customers.

I believe some of our own firms do not yet realise the extent of potential engineering business in South Wales, from the very largest structures and machines down to the smallest.

Moreover, when a customer or prospective customer has to visit a neighbouring country to inspect works and products I think he would as soon go to France as any other country. Many of our countrymen visit France for pleasure, and would like to visit it for business, and perhaps by combining the two make both pleasurable.

C. T. Allan,
Assistant Manager, South Wales E.P.D. Co.,
Cardiff.
December 31st, 1921.

Re Calendars and Almanacs.

The fifth note under this heading in your impression of December 23rd seems to have been written by no less a personage than St. Anthony of Padua. As the personage in question is apparently spending some of his spare time with you, it is difficult to know whom more to congratulate, yourselves or your readers.

Since the identity of the lady in the picture has been the subject of a considerable amount of inquiry, so that it may, in time, rank with that of Beatrice and La Gioconda in the realm of the conjectural, we are informed by an Arabian sage that this is an incarnation of the Fairy Péri-Bànou mentioned in Sir Richard Burton's translation of the "Arabian Nights," and, therefore, no doubt familiar to the majority of your readers. Further, that she owes her name to her origin from Perry Barr.

Ananias.

December 29th, 1921.

Leaves from an Inspector's Note Book.

Whilst disinclined to continue correspondence on this subject, in view of the compliment by Mr. Abraham that engineer surveyors "as a rule are very tactful, nice engineers," I do so only because I consider his attitude an altogether biased one, and very academical. My "guess" as regards his "throne" shaking he admits to be correct, but the other, as to bad overloading of the motor he tested, apparently was not. I ought to have also guessed, I suppose, that it was a blower motor, but the pity was that he did not say so previously. The two points on which I directly challenged him he has completely ignored; the reason is obvious.

Mr. Abraham has now dropped the small-salary complaint against inspectors, and enlarged on the "few exceptions" (of the "Anode" type), who are "bossy, conceited, and unlikeable individuals with opportunities," at the same time admitting that there are black sheep in every flock.

As to an "ass" being let loose on society as an engineer surveyor, take the case of such a one, due to friends' influence, being let loose on society as chief of an electricity supply undertaking; in time even he would, I feel sure, set fire to the

bushel hiding his light, and inflame even the retired grocer and pork butcher councillors he attempted to advise. It may be taken for granted that an insurance company would not suffer an "ass" of a surveyor long enough to damage its business connection.

Mr. Abraham advises insurance companies to stick to insuring plant which only is in the hands of laymen and handymen. His advice will be ignored, proving that his views on the subject are academical and out of touch with modern developments. Why, one of the largest manufacturers of electrical plant in this country insure the most valuable of their products (and it is inspected, too) during the guarantee period. If so (and these people will not be lectured from a switch gallery) their customers also you may depend have considered it a business proposition to continue the insurance, although they may employ engineers, and can ill-afford the luxury, so-called.

Engineer surveyors daily examining modern plant, such as mill equipment, electric furnace gear, both at the manufacturers' works and in operation, in addition to colliery plant and corporation power stations, and also dealing with breakdowns and instructing as to the repairs of practically all types and capacities of motors, generators, and transformers, &c., are quite competent to poke their noses into power stations and to rub shoulders with the chief, and entirely ignore the shift and switch engineer, although I have met a few of them who are decidedly more heady than their supposed superiors.

Engineer surveyors are to-day paid a salary in proportion to their years of service, and this is equal whether a man be boiler or electrical inspector. Most chiefs at power stations have nothing but praise (like Mr. Abraham), for very good reasons, of the boiler inspector, and I can assure them they will find the electrical inspector just as competent and nice, and can ignore 15-year old grievances and the "Anode" example.

H. W. Walker, A.M.I.E.E.,
Engineer Surveyor.

Sheffield,
January 2nd, 1922.

[By a misreading, for which he accepts the blame, Mr. Walker's initials were incorrectly given in the signature to his previous letter. If authors and correspondents, in addition to signing their MSS., would print their names in capitals, editors and compositors would be grateful.—Eds. Elec. Rev.]

I heartily endorse Mr. A. J. Abraham's remarks in his first letter regarding "Anode," but I must take exception to the phrase in his more recent letter in reply to Mr. H. W. Walker, in which he states that "even the shift engineer is his equal" (meaning "Anode"). Personally, I should be pleased to know why he made such an odious comparison, especially as it originates from one who has the honour which the letters after his name imply. Surely if he were engaging a "shift engineer" he would require a few more qualifications than those apparently possessed by "Anode"; or is he simply contented to have anything that drifts in? To use his own words, it leaves a very nasty taste, especially as he says: "*even* the shift engineer"; it sounds as though he had forgotten the accent on the "even." He must admit that among shifts there are men who excel their superiors both in practice and technical knowledge, but apart from this they are responsible for their shifts' maintenance of supply, so why they should be always dumped as the bottom dogs I cannot explain.

Super Tension.

January 1st, 1922.

The Severn Tidal Scheme.

In your leader to-day you state that this "scheme is admitted to be technically feasible," but has anyone with practical experience of the effects of the Severn and Wye mud and sand been consulted?

I took a personal interest in the matter for many years, and it seems to me that those who would "harness the tides" in this particular region have not taken fully into account the difficulties which will be caused by "silting" below the dam and by the filling up with mud of the reservoir above it—to say nothing of the cutting to pieces of parts of the underwater machinery by sand in suspension.

Severn Bore.

December 30th, 1921.

[Evidence was given before the Water-power Resources Committee by Mr. G. L. Addenbrooke, M.I.E.E., Mr. C. S. Meik, M.Inst.C.E., and Mr. J. W. Twinberrow, M.Inst.C.E., who jointly submitted a scheme; and by Mr. A. J. Liversedge, A.M.Inst.C.E., who also submitted a scheme. Sir Philip Dawson and Prof. A. H. Gibson were appointed a sub-committee "to examine the subject of tidal power on broad lines." The Committee concluded that "a number of physical and technical questions, some of general interest, and some peculiar to the conditions of the Severn, require to be investigated before a final pronouncement is possible with regard to the commercial practicability of utilising the tides for power purposes," and recommended that a special Technical Commission of Inquiry be appointed to carry out the investigation, with special reference to the Severn.—Eds. Elec. Rev.]

Mysterious Phenomena.

Will some of your readers kindly give their idea as to the cause of the two following cases:—

1. Why should it be possible to get a shock off a water tap when the pipes come out of the earth, this being a direct-current 3-wire 220/440 V slightly unbalanced circuit? This has happened, and is not imagination, as several persons at this works received the shock as well as myself.
2. At certain premises a number of steel pillars and galvanised iron buildings are in course of erection. The pillars go down into the earth about 3 ft., and I find that when I put a Sullivan 120-ohm headgear receiver in circuit with the iron pillars and earth (like earth to earth) I get strange noises like Morse code, the hum of a power station, and at other times sounds like an explosion. Is it electrolysis? and if so, why does it come out of the earth through the receiver and back to earth, when we understand that electricity takes the path of least resistance?

Ginger Beer.

Birmingham.

[It is quite possible for considerable differences of potential to exist between different points on the surface of the ground, owing to the resistance of the earth; horses have been killed by shock when passing near a lamp-post or tramway pole in which an electric circuit has broken down. Obviously the potential of the earth in contact with the pole may be 500 volts above that of the earth 20 or 30 ft. away, and thus a potential gradient is set up. In case (1) we should suppose that the water pipe was at the potential of the general body of earth, and that the floor on which the victim stood was at a higher potential, due to a leakage in some electric circuit. In case (2) it is not correct to say that "electricity takes the path of least resistance"; it takes *every* path, the current in each path varying inversely as the resistance of that path. The sounds heard in the telephone may be due partly to electrolytic origin, but more probably are due to the stray currents that exist in the earth, especially near tramways, &c.—Eds. Elec. Rev.]

A Message from Mars?

I shall be glad if any of the wireless experts who are readers of the Review can help me to get rid of annoying wireless signals, which keep one awake during the sleeping hours of the night. I have no electrical apparatus fixed in the house, nor do I understand the Morse code beyond one or two letters. My bedroom is directly over the bathroom, which contains the usual copper cylinder connected to earth, through the pipes. Is it possible the buzzing notes are radiated from this cylinder? What effective screen can be used against the trouble?

S. O. S.

St. Annes.
December 29th, 1921.

Cost of Living in Cuba.

Your correspondent will find that in Havana the cost of living is two to two and a half times the cost in England. In the provinces it is about one and a half times the cost of living in England.

In Havana he will find every modern convenience just as in a European capital, but in the provinces he may have to rough it, although I have stopped at sugar mills, miles from a railway station, where the living house for the staff has been fitted up like a first-class New York hotel.

The climate is delightful to anyone who can stand a moderate degree of heat, although Europeans are apt to suffer from prickly heat in the summer.

In Cuba you have the modern conditions of a fashionable resort in Havana, which the Cubans are trying to make into an American Monte Carlo, with the primitive life of the backwoods a few miles away.

Inglesite.

January 2nd, 1922.

Electricity on Aircraft.—Two luncheon parties in mid-air, each meal served by a London hotel waiter, were held on December 27th on board aeroplanes on the London-Paris service. One of the machines was a Goliath (Grands Express Aériens) flying to London, and the other was a Handley-Page machine on its way to Paris. To complete the Christmas atmosphere of the journey a Christmas tree, illuminated with electric lights (the work of Messrs. E. P. Allam & Co., of London), was set up in the saloon of the aeroplane.

What will be, it is claimed, the most luxurious flying ship in the world, with a perfectly-equipped electrically-operated kitchen capable of providing meals for 100 passengers, is under construction in Italy, says the *Daily Mail*. It is the new Italian airship *Napoli*, which is to be driven by twelve 300-h.p. engines.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

33,809. "Method of dimming electric head-lights of motor-cars, &c." K. E. Latimer. December 12th.
33,814. "Electric control of distant installations." Laboratorio Elettrotecnico Ing. L. Magrini. December 15th. (Italy, February 28th.)
33,819. "Electric heater." W. Schaufelberger. December 15th. (Switzerland, December 20th, 1920.)
33,820. "Electric motor." W. J. Baraby. December 15th.
33,852. "Apparatus for production of high-tension uni-directional currents of electricity." H. E. Donnithorne. December 16th.
33,860. "Electric fans." Cable Accessories Co., Ltd., A. Crawford & F. H. Reeves. December 16th.
33,879. "Automatic transmitter for wireless, signal light, and land telegraphy. H. J. Farrell. December 16th.
33,902. "Contact-rollers." E. von Pirch. December 16th. (Germany, January 15th.)
33,907. "Electro-magnetic apparatus for recording sound." A. F. Sykes. December 16th.
33,909. "Method of dimming electric head-lights of motor-cars, &c." K. E. Latimer. December 12th.
33,915. "X-ray spark coils." W. E. Schall. December 16th.
33,925. "Electric light, &c., fittings." Best & Lloyd, Ltd., & B. H. W. Spittle. December 16th.
33,927. "Electric immersion liquid-heaters." S. Abel. December 16th.
33,940. "Manufacture of grid resistances," L. Satchwell. December 16th.
33,941. "Electric couplings." J. M. de Vries de Waal. December 16th.
33,966. "Wireless receiving apparatus." J. W. Tennant. December 16th.
33,977. "Electric wringers and mangles." J. A. Duckworth, Whittaker Bros. (Accrington), Ltd., & W. Whittaker. December 17th.
34,023. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., & C. Gillings. December 17th.
34,024. "Electro-magnetic engines." R. Hacking. December 17th.
34,033. "Telephone receivers, auditory devices, &c." T. E. Stephens. December 17th.
34,041. "Insulating stands and holders or plugs for holding coils, &c., for use in electrical apparatus." H. D. Butler & G. H. Moody. December 17th.
34,053. "Oil switches." Sachsenwerk Licht-und Kraft-Akt-Ges. December 17th. (Germany, December 17th, 1920.)
34,054. "Coating electrical conductors." A. D. Shuter & W. S. Smith. December 17th.
34,057. "Electrolytic cells." J. Cranston & W. D. Le Bar. December 17
34,060. "Means for counting and recording number of telephone calls." T. F. Cummins and F. C. Poulton. December 19th.
34,064. "Automatic electric circuit-breakers." G. Wilkinson. December 19th.
34,070. "Mechanical and electrical display for vehicles." F. R. Francke. December 19th.
34,083. "Electro-magnetic manufacturing appliances." H. J. Monson. December 19th.
34,087. "Magneto and self-starter." C. T. A. Shearer. December 19th.
34,098. "Electric time-recording apparatus." A. H. Roberts and A. S. Willmot. December 19th.
34,108. "Electrical adaptors and wall plugs." W. F. Croll. December 19th.
34,125. "Apparatus for cooling and ventilating dynamo-electric machines." W. Bartel and O. Happel. December 19th. (Germany, December 17th, 1920.)
34,138. "Mercury-vapour air-pumps." Akt. Ges. Brown, Boveri et Cie. December 19th. (Switzerland, December 31st, 1920.)
34,139. "Toy wireless telegraphic or telephonic apparatus." P. C. Rushen (Bing Werke vorm. Geb. Bing Akt. Ges.) December 19th.
34,140. "Wireless telegraphy." S. G. Brown. December 19th.
34,142. "Electric resistances, &c." H. A. Watts. December 19th.
34,145. "Electric joints." E. A. Claremont and G. H. Scholes. December 19th.
34,149. "Electric lugs." E. V. Forde. December 19th.
34,156. "Electric motors, dynamos or generators." P. T. King. December 19th.
34,166. "Electric current collectors." British Thomson-Houston Co., Ltd., F. H. Clough, and H. W. H. Warren. December 19th.
34,170. "Storage batteries." Soc. de l'Accumulateur Tudor. December 19th. (Belgium, December 18th, 1920.)
34,187. "Electric filament lamp holders." W. W. R. F. Griffiths. December 20th.
34,188. "Electric switches." J. A. Crabtree. December 20th.
34,193. "Portable electric apparatus for attachment to domestic baths." W. M. Edwards. December 20th.
34,205. "Electrically-operated indicators, &c." J. Lovelase and J. Walster. December 20th.
34,206. "Supporting-clip for cables, &c." W. H. Coleman and F. W. Lees. December 20th.
34,222. "Telephone systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). December 20th.
34,223. "Telephone systems." Western Electric Co., Ltd. (Western Electric Co. Inc.). December 20th.
34,224. "Electric welding." W. Langdon-Davies and A. Soames. December 20th.
34,240. "Thermally-operated circuit-controllers." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). December 20th.
34,254. "Electric accumulator." K. Hansen. December 20th. (Denmark, October 4th.)
34,262. "Glass for use with electric lamps." Chance Bros. & Co., Ltd., and F. E Lamplough. December 20th.
34,286. "Galvanic batteries." Fuller's United Electric Works, Ltd., and A. P. Welch. December 20th.
34,293. "X-ray installations." H. Kress and Veifa-Werke Akt. Ges. December 20th.
34,297. "Electrodes for arc welding, &c." W. H. Boorne. December 20th.
34,306. "Telephone call counting, registering, and recording apparatus, &c." T. G. Anderson and G. H. Huntsworth. December 20th.
34,330. "Electric switches." E. C. Strong. December 21st.
34,345. "Electric rail-bonds." P. Croom-Johnson and H. T. Tudsbery. December 21st.
34,348. "Galvanic cells." H. G. Coventry and T. Rushton. December 21st.
34,349. "Magnetic cores." Western Electric Co., Ltd. December 21st. (United States, December 21st 1920.)
34,385. "Device for heating filaments in hot cathode X-ray tubes, valve tubes, &c." G. W. Walton. December 21st.
34,398. "Electric vaporising arrangement for using heavy fuel oils in motor-car engines." R. Callen. December 21st.
34,399. "Mechanism for use in telephony." A. J. H. Haddan (R. C. M. Hastings). December 21st.
34,405. "Electric insulators." British Thomson-Houston Co., Ltd. (General Electric Co.). December 21st.
34,408. "X-ray tubes." Westinghouse Lamp Co. December 21st. (United States, December 21st, 1920.)
34,431. "Magnetic control devices for electric arcs." Westinghouse Electric and Manufacturing Co. December 21st. (United States, December 21st, 1920.)
34,435. "Artificial lines for cable telegraphy." S. G. Brown. December 21st.
34,448. "Circuit connection fittings for electric wiring systems." L. M. Waterhouse. December 22nd.
34,454. "Electric switches." J. B. Tucker. December 22nd.
34,474. "Flexible coupling for magnetic machines, &c." C. Ditchburn, C. T. Dowey, and A. R. Vella. December 22nd.
34,480. "Sparking-plug." E. Martin. December 22nd.
34,481. "Automatic switches for electric systems of motor-vehicles." Brolt, Ltd., and W. Holt. December 22nd
34,502. "Electric switch boxes." A. L. Davis. December 22nd.
34,503. "Electrolytic iron." F. A. Eustis. December 22nd.
34,504. "Incandescent electric lamps." W. M. Rogerson and Stella Lamp Co., Ltd. December 22nd.
34,510. "Impulse-sending devices for telephone, &c., systems." Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). December 22nd.
34,511. "Printing telegraphs." Kleinschmidt Electric Co., Inc. December 22nd. (United States, December 22nd, 1920.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1920.

17,975. "Ignition systems for combustion engines." M. Polak (deceased). June 30th, 1920. (172,348.)
18,412. "Dynamo-electric machines." H. Charlet. July 2nd, 1920. (172,349.)
18,987. "Vacuum discharge apparatus for the protection of electrical circuits." F. Schroter. January 29th, 1914. (147,033.)
19,063. "Modulation systems for wireless signalling and the like." J. Scott Taggart and Radio Communication Co., Ltd. July 6th, 1920. (172,350.)
19,089. "Reception of electric oscillations." Ges. fur Drahtlose Telegraphie. May 2nd, 1916. (147,701.)
20,580. "Driving systems for alternating current meters according to the Ferraris principle." Dr. P Meyer Akt. Ges. June 12th, 1919. (148,576.)
20,717. "Sparking plugs." Soc. Internationale pour l'Exploitation de la Bougie Sol. July 15th, 1919. (Patent of addition not granted.) (148,894.)
21,831. "Electric illuminating devices for theatrical stages, kinemas, and the like." T. H. Rochford. July 21st, 1920. (172,353.)
22,669. "Electric stop motions for machines operating with yarns or threads." A. Roberts. July 30th, 1920. (172,357.)
23,208. "Electrical connecting and supporting devices." Electric Outlet Co. Inc. April 9th, 1920. (161,546.)
24,547. "Electron discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.). August 24th, 1920. (172,593.)
25,031. "Means for transmitting messages." J. C. Grant. August 30th, 1920. (172,374.)
25,065. "Radio receiving systems." J. Scott Taggart and Radio Communication Co., Ltd. August 31st, 1920. (172,376.)
25,232. "Application of the bark (suber) of Melaleuca Leucadendron to thermic, hydraulic, and dielectric devices." P. E. H. Roussan. October 3rd, 1919. (151,977.)
25,258. "Electrical rivet heating machine." J. Moll. September 1st, 1920. (172,384.)
25,301. "Self-regulating dynamos." H. H. Smith and T. G. P. Healey. September 2nd, 1920. (172,387.)
25,370. "Signalling systems, particularly wireless modulation system." J. Scott Taggart and Radio Communication Co., Ltd. September 2nd, 1920. (Cognate application 11,061/21.) (172,389.)
25,376. "Holders for electric incandescent lamps." D. M. G. R. de La Pichardais. September 3rd, 1919. (150,726.)
25,387. "Systems and apparatus for converting alterating electric current into direct current." W. A. Price. September 2nd, 1920. (172,391.)
25,388. "Electric arc projection apparatus." Etablissements Continsouza Soc. Anon. November 19th, 1919. (154,177.)
25,408. "Radio signalling systems." J. Scott Taggart and Radio Communication Co., Ltd. September 3rd, 1920. (172,394.)
25,445. "Rheostats." Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.). September 3rd, 1920. (172,396.)
25,875. "Wiring of the ignition system of internal-combustion engines." L F. Lambert. September 8th, 1920. (172,419.)
25,967. "Luminous electric discharge lamps." E. Schaffer. September 9th, 1919. (150,957.)
26,354. "Telephone transmitter mouthpieces." C. E. Q. Ollife. September 14th, 1920. (172,428.)
26,382. "Electrically-operated warning signals." D. McGregor. September 15th, 1920. (Cognate application 12,059/21.) (172,429.)
26,509. "Headlights." C. E. Fink. September 16th, 1920. (172,432.)
26,525. "Overload electric switches." T. W. Rogers (F. Krupp Akt. Ges.). September 16th, 1920. (172,433.)
26,650. "Electric power limiting systems." British Thomson-Houston Co., Ltd (General Electric Co.). September 17th, 1920. (172,436.)
26,676. "System for measuring the capacities of electric conductors." J. Urmston, R. N. James and Callender's Cable & Construction Co., Ltd. September 17th, 1920. (172,437.)
26,889. "Means for controlling electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). September 21st, 1920. (172,440.)
26,935. "Electrical means for indicating at a distance the direction of motion of an apparatus." Evershed & Vignoles, Ltd., and J. C. Needham. September 21st, 1920. (172,445.)
26,990. "Electrical cut-out." W. H. Illingworth. September 22nd, 1920. (172,446.)
27,011. "Electrical speed-regulator systems." L. Miller and Metropolitan-Vickers Electrical Co. Ltd. September 22nd, 1920. (172,447.)
27,748. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd (Automatic Electric Co.). September 30th, 1920. (172,460.)
27,762. "Casings for electrical and other apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). September 30th, 1920. (172,461.)
28,092. "X-ray apparatus." W. D. Coolidge. July 9th, 1920. (166,097.)
29,608. "Electric pocket lamps." Cosmophos-Werke Akt. Ges. and C. Boltshauser. October 20th, 1920. (172,482.)
30,906. "Process of telephony and telegraphy by high-frequency currents and stationary periodicity transformers." Ges. fur Drahtlose Telegraphie. October 26th, 1920. (154,885.)
33,028. "Push-button control electric lifts and the like." Waygood Otis, Ltd. (Otis Elevator Co.). November 23rd, 1920. (172,510.)
33,059. "Radio signalling systems for lifeboats." E. C. Hanson. February 20th, 1919. (154,533.)
33,158. "Electrical starting mechanism for internal-combustion engines." H. Lucas and W. C. Turner. November 24th, 1920. (172,512.)
34,703. "Hand-rests for electric polishing lathes." B. Platschick. December 8th, 1920. (158,542.)

1921.

368. "Electric safety fuse." A. L. Eustace. March 14th, 1917. (158,493.)
1,102. "Spark-gaps for electro-magnetic wave-signalling systems." F. Lowenstein. August 25th, 1914. (157,258.)
8,247. "Frequency multipliers for alternating electric currents." P. Trichard. March 16th, 1920. (160,179.)
16,724 "Electric water heater." W. Colebrook. September 22nd, 1920. (Divided application on 152,012.) (172,582.)
22,361. "Electrical connecting and supporting devices." Electric Outlet Co. (Inc.). April 9th, 1920. (Divided application on 161,546.) (168,320.)
29,489. "Miners' and other electric lamps." E. A. Hailwood. August 25th, 1920. (Divided application on 24,597/20.) (172,592.)